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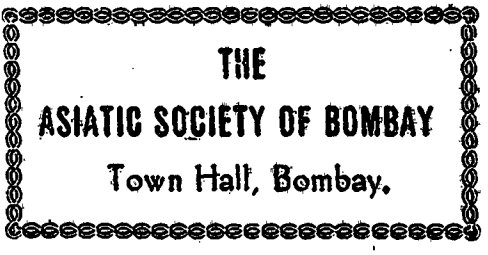

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SELECTIONS

FROM

THE RECORDS

OF THE

GOVERNMENT OF INDIA.

(HOME DEPARTMENT.)

Published by Authority.

N°. X.

108414

Papers

ON THE

COAL OF THE NERBUDDA VALLEY,

TENASSERIM PROVINCES,

AND

THAYET-MYO.

Calcutta:

THOS. JONES, "CALCUTTA GAZETTE" OFFICE.

1856.

00108414

No. 58.

FROM

THE UNDER-SECRETARY TO THE GOVT. OF BENGAL,

TO

THE UNDER-SECRETARY TO THE GOVT. OF INDIA,
In the Home Department.

Dated Fort William, 24th January 1854.

MARINE.

SIR,

I AM directed by the Most Noble the Governor of Bengal to transmit herewith, for the consideration and orders of the Governor General in Council, an Extract of a Despatch* from the Hon ble the Court of Directors, relative to proceedings connected with the Geological Survey referred to therein.

* Para. 29, No. 28 of 1853, in the Marine Department, dated 9th November.

I have the honor to be, &c.,

(Signed) W. GORDON YOUNG,
Under-Secy. to the Govt. of Bengal.

Extract from a Despatch from the Hon'ble the Court of Directors in the Marine Department, (No. 28 *of* 1853,*) dated 9th November.*

Para. 29. WE observe that, at the suggestion of Professor Oldham, you have sanctioned his conducting the Geological Survey in future on a continuous and regular plan, instead of selecting for examination isolated and often widely separated tracts of country. From Sikree Gully, in the neighbourhood of Rajmahal, where he was employed at the date of your letter, he was to proceed regularly to the Westward, including in his survey all the country South of the Ganges as far as the published Revenue Survey map or maps of the Indian Atlas extend, that is to say, to some distance beyond the Sutlej. Such a syste-

31 to 36, Proceedings connected with the Geological Survey.

matic course is no doubt in most respects preferable to the other, and we see no objection to its adoption, unless it should appear likely to occasion a much longer postponement of the survey of the coal fields of the Nerbudda Valley, to which we can scarcely attach too much importance when we bear in mind the great expense and practical difficulty of supplying the Bombay Government with all their coal from Europe as at present. We infer, however, from a passage in Professor Oldham's letter that a cursory examination, sufficient for practical purposes, might be made of any detached District, with respect to which geological information was immediately required without seriously interrupting the progress of the main survey. If this inference be correct, the Nerbudda District ought to be the earliest examined, and we wish this to engage your immediate attention.

(True Extract)

(Signed) W. G. YOUNG,
Under-Secy. to the Govt. of Bengal

No. 160.

To

W. G. YOUNG, Esquire,
Under-Secy. to the Govt. of Bengal.

Home Department.

Sir,

I am directed by the Most Noble the Governor General in Council to request that a copy of the Extract from the Hon'ble Court's Despatch, forwarded with your letter No. 58, dated the 24th ultimo, may be communicated to Professor Oldham, and that gentleman's opinion obtained as to the feasibility of an immediate cursory survey of the coal fields of the Nerbudda Valley, to which the Court attach so much importance.

I have the honor to be, &c.,

(Signed) G. COUPER,
Under-Secy. to the Govt. of India.

Council Chamber,
The 10th February 1854.

No. 236.

FROM

THE SUPT. OF THE GEOLOGICAL SURVEY,

TO

W. GORDON YOUNG, ESQUIRE,
Under-Secy. to the Govt. of Bengal.

Dated 2nd March 1854.

SIR,

I HAVE the honor to acknowledge the receipt of your letter No. 119, dated 21st February 1854, enclosing, by order of the Most Noble the Governor of Bengal, copy of a letter from the Government of India in the Home Department, and of an Extract from a Despatch from the Hon'ble the Court of Directors, (No. 28 of 1853,) relating to the geological examination of the District of the Nerbudda.

In reply I have the honor to report for His Lordship's information, that the Hon'ble the Court have correctly interpreted my views, as conveyed in my letter No. 130, dated 2nd September 1852; and with reference more immediately to the valley of the Nerbudda, I conceive such a cursory examination of that District, not only feasible, but highly desirable. The Hon'ble the Court of Directors have indicated the great practical importance of that District, and I have already, on more occasions than one, stated my conviction, that in a purely geological point of view, the Districts of Central India will afford the best and clearest key to the true succession of the rocks in India.

But I must at the same time state, that such an examination of a District, lying at a very considerable distance from the country now under survey, must inevitably impede the general progress of our work, unless a corresponding increase to the staff of the survey should be sanctioned.

I do not consider the distance of the Nerbudda as any objection to its examination, excepting so far as results from the slowness and expense of moving about in this country. In some respects it offers a positive advantage. It is quite impossible for any geologist, however experienced, to gain a satisfactory knowledge of the structure of a new country, respecting which but little information had been previously acquired (and that little at distant points by isolated observers) without visiting a large—in some case, a *very large* area. Phenomena difficult of explanation, and unintelligible within a limited area, become at once clear, and instructive, when the clue has been obtained in some adjoining Dis-

trict. In this way I might remark that, although the first cold season which I spent in this country (1851-52) was without any result, so far as the examination or mapping of any new District was concerned, nevertheless, without the knowledge I then obtained by visiting the Damooda Valley and its coal fields, the country in which we have been since engaged would have been only half understood. Nor could any person, first placed in the Nerbudda Valley, fairly unravel its structure, without visiting the coal districts of Bengal.

I respectfully conceive therefore, that it would be much more advantageous to extend the present establishment of the Geological Survey than to form any new staff for the investigation of other Districts. In fact every such party, if isolated, would, of necessity, be working from its own horizon or datum; and it would require nearly as much labour afterwards to render their various results truly comparable as to have made them so in the first instance. The advantages of individual superintendence for very extensive Districts have been long acknowledged in Europe, where, from the facilities of comparison, it is even less required than in India.

I would further state, that should such an examination of the Nerbudda Valley be decided upon, the present would seem a favorable time for its prosecution. As far as any published accounts enable me to judge, the District in which we should, in the regular progress of the survey, be engaged during the next cold season (1854-55) will not prove a very complicated one, so that my personal examination of it would be less essential.

Should the suggestion for an increase to the staff of the Geological Survey, corresponding to the increase in the area over which its labours would extend, be entertained, I should be quite prepared, with His Lordship's permission, to submit in detail my views and an estimate of the cost of such increase.

I would further venture to suggest, that the local authorities might be requested to furnish a summary statement of the localities in which coal, iron, or other minerals are known to occur, in the vicinity of the Nerbudda, with any useful information that the records of their offices may afford.

I have, &c.,

(Signed) THOMAS OLDHAM,
Supdt. of Geological Survey of India.

Camp Ungargurria, near Soory,
The 2nd March 1854.

No. 153.

COPY of the above letter forwarded to the Home Department, with reference to their letter No. 160, of the 10th February 1854.

By order of the Most Noble the Governor of Bengal,

(Signed) W. GORDON YOUNG,
Under-Secy. to the Govt. of Bengal.

Fort William,
The 8th March 1854.

No. 346.

To

THE UNDER-SECRETARY TO THE GOVT. OF BENGAL.

HOME DEPARTMENT.

SIR,

WITH reference to the Report of the Superintendent of Geological Survey of India, dated the 2nd instant, forwarded by you by endorsement, dated the 8th idem, I am directed to inform you, that the Commissioner in Saugor and the Resident at Indore will be called upon to furnish any information that they may possess, or the records of their offices may contain, in respect to the localities in which coal, iron, or other minerals are known to occur in the vicinity of the Nerbudda. In the meanwhile you are requested, under the orders of the Government of Bengal, to instruct the Superintendent to submit, for the approval of the Supreme Government, a list of the extra establishment which he considers will be necessary to enable him to prosecute a cursory survey of the coal fields, &c., of the Nerbudda Valley.

I have the honor to be, &c.,

(Signed) G. COUPER,
Under-Secy. to the Govt. of India.

Council Chamber,
The 24th March 1854.

No. 332.

To

THE SECRETARY TO THE GOVERNMENT
OF THE NORTH-WESTERN PROVINCES.

HOME DEPARTMENT.

SIR,

I AM directed to forward, for submission to the Hon'ble the Lieutenant-Governor, the accompanying Extract, para. 29, from a Des-

patch from the Hon'ble the Court of Directors in the Marine Department, No. 28 of 1853, dated the 9th November, together with copy of a letter from the Superintendent of Geological Survey of India, dated the 2nd instant, relative to the prosecution by him of a cursory survey of the coal fields of the Nerbudda Valley.

2. To enable Professor Oldham to enter upon this duty immediately, I am directed to request that His Honor the Lieutenant-Governor will be pleased to require the Commissioner of Saugor to furnish, for communication to the Superintendent, any information that he may possess, or the records of his office may contain, in respect to the localities in which coal, iron, or other minerals are known to occur in the vicinity of the Nerbudda.

I have the honor to be, &c.,

(Signed) C. ALLEN,
Offg. Secy. to the Govt. of India.

Fort William,
The 24th March 1854.

No. 311.

FORT WILLIAM,

HOME DEPARTMENT,

The 24th March 1854.

READ again Extract, para. 29, from a Despatch, from the Hon'ble the Court of Directors, in the Marine Department, No. 28 of 1853, dated the 9th November, relative to the prosecution by Professor Oldham, Superintendent of Geological Survey of India, of a cursory survey of the coal fields of the Nerbudda Valley.

Read a letter from Professor Oldham on the subject, dated the 2nd instant.

Ordered that copies of the foregoing papers be sent to the Foreign Department, with the request that the Resident of Indore may be required to furnish, for communication to the Superintendent, any information that he may possess, or the records of his office may contain, in respect to the localities in which coal, iron, or other minerals are known to occur in the vicinity of the Nerbudda.

No. 916 OF 1854.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to the Govt. of the North-Western Provinces,

TO

CHARLES ALLEN, ESQUIRE,
Secy. to the Govt. of India, Home Department,
Fort William.

Dated the 20th April 1854.

GENERAL DEPARTMENT.

SIR,

WITH reference to your letter No. 332, dated 24th ultimo, I am directed by the Hon'ble the Lieutenant-Governor to intimate, for the information of the Most Noble the Governor General in Council, that instructions have this day been issued to the Commissioner, Saugor and Nerbudda Territories, to place himself in direct communication with Professor Oldham, Superintendent of Geological Survey of India, and to furnish him with the information required, regarding the geological features of the valley of the Nerbudda.

I have the honor to be, &c.,

(Signed) W. MUIR,
Secy. to the Govt. of the North-Western Provinces.

The 20th April 1854.

No. 288.

FROM

THE SUPT. OF THE GEOLOGICAL SURVEY,

TO

CHARLES ALLEN, ESQUIRE,
Secy. to the Govt. of India, Home Department.

Dated the 11th October 1854.

SIR,

THE great and growing demand for coal, and the fair prospects of obtaining a considerable supply from the Tenasserim Provinces,

have rendered it advisable, that I should, with a portion of my geological party, proceed to that District during the coming cold season. I am, however, very anxious to obtain as much sound information as possible, regarding the Nerbudda Valley, during the same time; but the smallness of my party at present, owing to the recent appointment of Mr. Henry Medlicott as Professor of Geology at the Roorkee College, prevents my being able to detach more than *one* Assistant to that District. I am therefore very desirous, as a temporary arrangement, to obtain the aid of Mr. Medlicott during this season. I am informed by him, that the period of the year set apart for lectures is during the rains, and that his absence from Roorkee during the working season would not interfere with his regular course of instructions. At the same time I am disposed to think, that the valley of the Nerbudda offers a better prospect of immediate returns of value than any of the Districts more immediately in his neighbourhood, on which he might be engaged.

I would, therefore, solicit the sanction of the Most Noble the Governor General to an application being made to the local authorities, North-Western Provinces, for the services of Mr. Henry Medlicott, during four months of the coming season (December to March or January to April as convenient,) with a view to his undertaking the examination of the Nerbudda District, in connexion with one of my Assistants.

In the event of this being sanctioned, I would recommend that Mr. Medlicott should be authorized to receive an allowance of Rupees 400 per month, said sum to include all usual allowances for travelling charges, horse, &c.; his regular pay as Professor at the Thomason College of course being continued during his absence on this duty.

Before the ensuing cold season I trust the establishment of the Geological Survey will be so complete, that such temporary arrangements will be unnecessary.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,
Supdt. of Geological Survey.

Monghyr,
The 11th October 1854.

No. 1132.

To

T. OLDHAM, ESQUIRE,
Supdt. of the Geological Survey in India.

HOME DEPARTMENT.

SIR,

IN reply to your letter No. 288, dated the 11th instant, I am directed to inform you, that the Government of the North-Western Provinces has been requested to place the services of Mr. H. Medlicott at the disposal of the Government of India, with the view to his being employed in the examination of the Nerbudda Valley.

2. The Government of the North-Western Provinces has been further requested, in the event of Mr. Medlicott's services being made available, to direct him to place himself at once in communication with you.

3. Should Mr. Medlicott be employed on the proposed duty, the Most Noble the Governor General in Council will be prepared to sanction the grant to him of the extra allowance recommended by you, *viz.*, Rupees 400 per mensem, to cover all expenses of travelling, &c.

I have the honor to be, &c.,
(Signed) C. ALLEN,
Offg. Secy. to the Govt. of India.

Fort William,
The 20th October 1854.

No. 1131.

To

THE SECRETARY TO THE GOVERNMENT
OF THE NORTH-WESTERN PROVINCES.

HOME DEPARTMENT.

SIR,

I AM directed to forward, for submission to the Hon'ble the Lieutenant-Governor, the accompanying copy of a letter from the Superintendent of the Geological Survey in India, No. 288, of the 11th instant, and to request that His Honor will have the goodness to place the services of Mr. H. B. Medlicott at the disposal of the Government of India temporarily for a period of four months, with the view of his undertaking the examination of the Nerbudda Valley.

2. In the event of Mr. Medlicott's services being made available, you will be good enough to direct him to place himself at once in communication with Professor Oldham.

I have, &c.,

(Signed) C. ALLEN,
Offg. Secy. to the Govt. of India.

Fort William,
The 20th October 1854.

No. 1392 A. OF 1854.

FROM

WILLIAM MUIR, ESQUIRE,
Secy. to the Govt. of the North-Western Provinces,

TO

CHARLES ALLEN, ESQUIRE,
Offg. Secy. to the Govt. of India, Home Department,
Fort William.

Dated Camp Mynpoory, the 16th November 1854.

GENERAL DEPARTMENT.

SIR,

I AM directed by the Hon'ble the Lieutenant-Governor to acknowledge the receipt of your letter, No. 1131, dated the 20th ultimo, with its enclosure, and in reply to state, for the information of the Most Noble the Governor General of India in Council, that as therein requested, His Honor has this day placed the services of Mr. H. B. Medlicott at the disposal of the Government of India temporarily, with the view of prosecuting an examination of the Nerbudda Valley.

I have the honor to be, &c.,

(Signed) W. MUIR,
Secy. to the Govt. of the North-Western Provinces.

Camp Mynpoory,
The 16th November 1854.

No. 1211.

COPY forwarded to the Superintendent, Geological Survey, in continuation of the letter from this Department, No. 1132, dated the 20th ultimo.

By order, &c.,
(Signed) W. G. YOUNG,
Under-Secy. to the Govt. of India.

Home Department,
The 23rd November 1854.

No. 30 A.

FROM
THE SUPT. OF THE GEOLOGICAL SURVEY,
TO
CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India.

Dated the 19th July 1855.

SIR,

I HAVE the honor to forward herewith, for the information of the Hon'ble the President in Council, and for communication, if desirable, to the Governments of Bombay and of the North-Western Provinces, a brief summary of the results of the examination of the Nerbudda Valley during the past season, so far as regards the commercial value of the coal and iron deposits known to occur in that District.

As I stated at the time when the examination of the Nerbudda Valley was ordered by the Most Noble the Governor General in Council, that one season would not suffice for the full investigation of so extended an area, my instructions to Mr. Medlicott, on proceeding there, were that his primary and special attention should be given to such points as afforded any prospect of future commercial importance, reserving a more detailed search in elucidation of geological questions and for the discovery or further tracing out of these deposits for a future time, as it was desirable that some definite information should be laid before the Government at as early a period as possible; and the President in Council will perceive that these instructions have been fully carried out.

I would also add, that having been misled by the information I received in reply to my enquiries on the subject, as to the period of the year at which it would be safe to enter the Nerbudda Valley, I delayed Mr. Medlicott at other work in Bengal, so that he only reached the Nerbudda District in January, although he then found that the resident authorities usually proceeded into their Districts some two months earlier. This un-

fortunately reduced the working season in that part of the country very considerably, but such an error will of course be avoided in the coming year.

The discussion of more purely geological questions, requiring for their illustration plans and sketches, which always involve time in their preparation, is reserved for a future occasion.

I would further state, that I look upon this Report as very highly creditable to Mr. Medlicott, under whose charge the small party working in that District were placed. The facts he mentions, and the inferences he draws, for the most part, are confirmatory of the statements of previous observers; and in all cases where his conclusions differ from those previously arrived at, his reasons appear to me satisfactory. To instance one point, I believe he has, for the first time, explained the true cause of the superiority of the Tendukhera iron, by showing that the ore is naturally and unavoidably combined with its proper flux. In other points he has stated his conclusions fully, and they do not call for any further remark.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,
Supdt. of Geological Survey.

Prome,
The 19th July 1855.

The original Report was in the form of a letter to myself and I have not altered it.

To

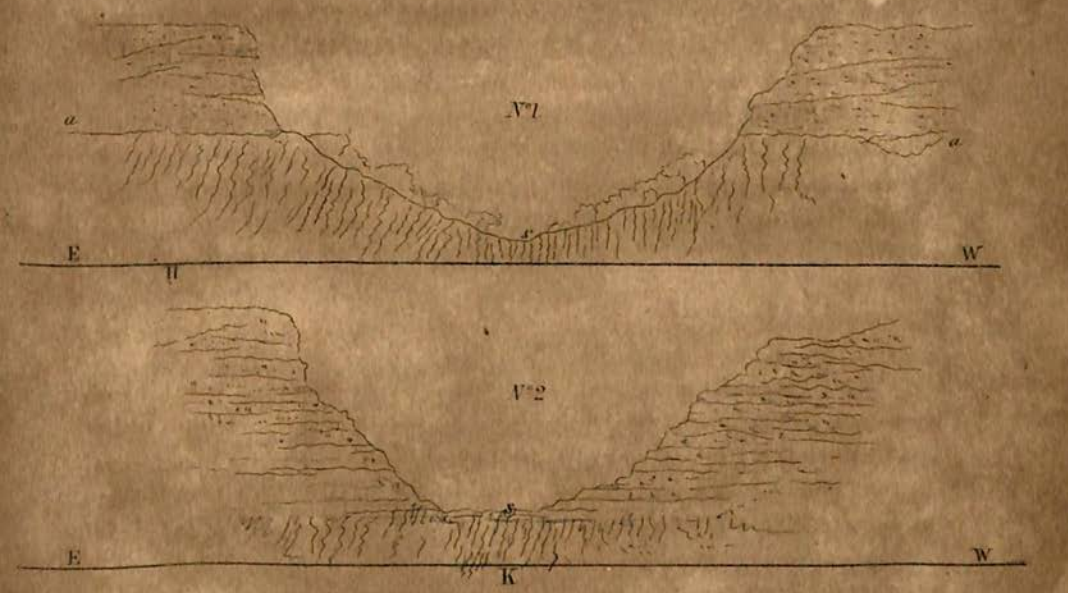
THOMAS OLDHAM, ESQUIRE,
Superintendent of Geological Survey.

THE coal-bearing rocks of the Nerbudda Valley, as you are already aware, extend along its South side; the escarpment of the hills in that direction being for the most part composed of the beds of the coal-bearing conglomerate and sand-stone. This is the case at least from Gaugra, South of Nursingpore, to near Seeoni, in the Hoosingabad District, including a distance of about 120 miles in a straight line, between which places I examined that part of the Goandwarra range which lies along the Nerbudda Valley, namely, its escarpment to the North, on and near which all the known out-crops of coal are. I was prevented from penetrating far into the interior of these hills, by the necessity of visiting all these known localities and the short time left to accomplish that undertaking, which rendered it impossible to attempt a journey into a

country covered with dense jungle, almost totally without cultivation, where there are few villages, no roads, and scarcely even a path along which a poney or loaded ox can travel.

The information then which I have to place before you is confined to that part of the area covered by coal-bearing rocks which are known to extend far to the East and South. Within the area which I have visited, however, occur all, or nearly all, those localities where coal has been found by previous explorers, and principally to these localities I shall call your attention. Taking them as they are met with in proceeding from East to West, the first is that situated on the Hurd Nuddee, near its junction with the Sakur.

The following Sketch Sections will help me to convey more intelligibly what I have to say about this part of the field :—



No. 1 is taken across the entrance to the gorge, out of which the Sakur Nuddee flows. The course of the stream is represented at S. H. is the position of the village of Hutnapur; projected on the section it really stands in the plain; and North of the line of section altogether, at *(a)*, the beds of coal-bearing conglomerate rest on the lime-stone of the schist formation, which I have represented as dipping at high angles and contorted, though here it is hardly to be seen at all. Occupying as it does the lower third of the height of the hill, it is covered by the talus of broken fragments from the upper beds. The conglomerate is composed, in its lower beds, of pebbles of the schist rocks, the maximum size of which seems to be 5 inches diameter, but the average much smaller. The higher beds are composed exclusively, or nearly altogether, of small rounded pebbles of quartz and jasper. There is no sand-stone seen here.

Hurd Nullah.

No. 2 is taken parallel to No. 1 and crosses the gorge in an East and West direction, about a mile and a half further up the stream or South; S being the Sakur stream and K the position of the village of Konda.

No. 3 is supposed to run at right angles to the other two. Taking the Sakur Nuddee for its base, and showing the general features as you look to the East, H represents the position of the village of Hutnapur, S and K as before, and *(a)* the same as in No. 1.

As you ascend the gorge the lime-stone is lost under the coal-bearing sand-stone, and I have represented, in Nos. 2 and 3, how the vast number of immense blocks of conglomerate, which have fallen from the beds high on the hill-side, renders it very difficult to make out satisfactorily the real position of the rock beneath, although they give to the gorge an exceedingly picturesque appearance: thus it is obscure what the rock is which actually rests upon the lime-stone, near the village of Konda (K in sections.) I have represented in Sections 2 and 3 beds of sand-stone lying on the lime-stone near Konda, which have replaced the conglomerates seen in the hill-side at *(a)*, and in my section have taken for granted that the said conglomerate beds do not continue under them. This would imply the probability, that there is now exposed along the escarpment, at the North of this range, what was the original shore of the coal-bearing basin; that the conglomerates there seen were being formed at the edge of that basin, while sand-stones, shales, &c., were being deposited in the deeper water to the South; the result of which deposits we now see in the sand-stones and shales exposed at Konda and

thence along to the junction of the Hurd and Sakur. Although this I believe to be the true state of the case, yet, from the obscurity before mentioned, and the difficulty of seeing clearly if the sand-stone beds near Konda really rest on the lime-stone or not, there remains the possibility of a fault, which, running East and West, may have had a sufficient downthrow to the South, to have let down all the conglomerates seen at *(a)*, which would thus underlie what we see from Konda up the Sakur, and also the lowest sand-stones exposed in the Hurd section.

There is every kind of presumptive evidence against this supposition, and I reject it the more readily as I have never seen any rocks in which the characteristics developed in any one spot are so little persistent in horizontal range as here; and after an acquaintance with the formation, extended over 200 miles at least of its range, and not altogether slight, I find little difficulty in believing that the great beds of conglomerate at *(a)* are represented at not more than a mile off, by a few pebble runs of coarse sand-stone and pebble beds. Thus I arrive at the conclusion, that the sand-stone seen in the stream near Konda, Sections 2 and 3, is really the bottom rock of the formation there; and so, if this supposition be good, the bottom rock seen in the Hurd Nuddee may be also taken as equivalent to the same; and the section there exposed, a fair representation of the lowest member of these coal-bearing rocks in this part of the field.

The thickness of these lowest beds cannot be seen in the Hurd Nuddee. There are several of them well exposed; the stream cuts through and hollows out the immense blocks of which these beds seem composed; they are 20 to 30 feet thick; the rock a pale grey and brown sand-stone, rather fine-grained, loosely-aggregated, and very uniform in texture, with remarkably little mica Along the partings and in the cracks and joints a ferruginous red argillaceous grit is often formed, which is very hard, concretionery in some places, and often rich in iron. This may be taken as the characteristic rock of the coal-bearing formation, and it at least varies very little from the type wherever I have seen it.

Here, among the lowest beds, there are seen layers of white grit, with alternate lamina of carbonaceous matter, and higher up in the section many concretions of red iron-stone occur. These accumulations, which characterize the upper portion of these lowest rocks, are striking from their size and the way in which the weathering of the rock exposes them. Some, affecting an oval shape, measure 20 feet on the longer by 10 feet

on the shorter diameter, and are six to ten inches thick in the centre; others are very irregular in outline and thickness, and most seem to be rich ores of iron. The dip of these lowest beds varies considerably in degree and direction—20° to S. E. may be taken as the average. Above these comes

Shale No. 1—dark blue, earthy, inconstant in thickness, with carbonaceous partings and some faint vegetable impressions. No coal. Ascending sand-stone, single bed, five feet thick, including a layer of grit more compact than the typical sand-stone described. It forms the floor of

Shale No. 2—ten feet thick, greyish blue and micaceous; includes at about one-third from the top a parting of ferruginous grit 3 to 4 inches thick. Throughout these are layers, some more micaceous, some more carbonaceous, recurring and alternating at intervals, the latter often sufficiently strong to give a dark colour to many portions of the mass. They abound in vegetable impressions, seldom however well preserved. Above the grit parting above-mentioned, and near the top of this shale No. 2, there are two small irregular bands of coal 2 to 3 inches thick in some parts of their horizontal range. These little bands are free from those admixtures of clay and mica which generally characterize them, but more frequently the impurities so predominate as to leave a micaceous shale scarcely darkened by some patches of carbonaceous matter, and thus they die out and come in again. This shale is here cut off by a fault which runs S. 55 E. and is a downthrow to the South. On the North of the fault, shale No. 2 disappears under a sand-stone 2 feet thick, on which rests

Shale No. 3—which is precisely like shale No. 2; it contains a band of rich red hæmatite, in some places 4 inches thick, but very variable. Above comes in sand-stone, typical coal-bearing rock. Then

Shale No. 4—seven feet of blue and grey argillaceous and carbonaceous shale, with micaceous bands, and also containing leaf impressions, but no coal. Sand-stones 10 feet. Typical coal-bearing sand-stone perhaps slightly more micaceous than in its normal character.

Shale No. 5—1*st*, at bottom there is a little band of coal 10 to 14 inches thick, but very unpromising in aspect. Along 100 yards of its out-crop, which is here exposed, the quantity of carbonaceous matter is very variable, indeed much of the bed would not support combustion; and where best in quality, the true coal seems to collect into a thin layer in the centre of the little band, leaving the latter destitute of carbonaceous matter above and below.

2*nd.*—A sand-stone bed 2 feet thick, with many bands of carbonized vegetable impressions and frequent nodules of pyrites.

3*rd.*—A dark-colored shale 2 to 3 feet thick.

4*th.*—Sand-stone 2 to 4 feet thick, hard, red, and full of nodules of pyrites.

5*th.*—Dark-colored shale 1 foot 6 inches, containing many carbonized vegetable impressions. Here I found distinct zamia-like leaves, some reed or grass stems, and two fern leaves, which occur in the higher beds of shale in the Rajmahal Hills.

Shale No. 5, with its out-divisions, is covered by massive beds of sand-stone, in which I did not succeed in detecting any of those land-marks which would warrant the continuation of a measured section.

You will remark that I have not attempted any great precision in my statements of measurements, which I have given in the above section. The *habit* of the rock renders it quite useless so to do, and were I to copy the measurement of each bed, as made on the ground, I should run the risk of misrepresenting the general character of the Section instead of conveying a true idea of it. All the beds seem to partake even more than is usual in a sand-stone formation of the "lenticular" manner of arrangement; seldom persists in any one characteristic along the horizontal range; and where a bed of shale does look as if it maintained its general appearance, thickness, &c., a closer examination will show that the elements of which it is composed *do* vary notwithstanding, and it will be found to become more or less carbonaceous, &c.

Although I followed the course of the Sakur for several miles into the hills along its banks, I found only the thick rolling beds of the coal-bearing sand-stone exposed, all of which is over the Hurd section, unless a fault, which I have failed to detect, cuts off the continuity; but a very great thickness is not necessarily implied, and save the beds seen in positive succession one over the other in the hill-side, little secure data for estimating thickness by the dip can be attained, without a very careful examination of the rocks up the many almost inaccessible ravines which intersect them.

Captain Ouseley mentions this place, stating the coal to be 3 feet thick. I believe, nevertheless, that I have not under-stated the value of *what is seen*, and that it is worthless commercially, and offers no reasonable prospect whatever of repaying the labour of digging down on the chance of improvement. Some iron might no doubt be got out, but I

think with profit only if taken along with something else on the spot: alone it never could pay. The expense of a road from here to the plain of the Nerbudda Valley would be very considerable—in short it never could be profitably worked; but I think the section may prove interesting when the country to the South comes to be examined, as it will serve for a starting point from the base of the formation and help to throw light on the structure of the central portion of the basin.

Mopani or Benar.

The next locality to which I have to conduct you is Mopani or Benar, at a short distance from each of which villages the Sitarewah Nuddee exposes a section of the coal-bearing rocks, at a distance of little more than a mile from the place where that stream leaves the hills for the plain ground of the Nerbudda Valley. Traces of the rocks of the schist formation are seen exposed in its banks, but all such are covered up by the gravel, red clay, and black surface soil through which the stream has cut its way, as its course is ascended and long before the foot of the hill is reached. Still there is reason to think that the first rock come to rests at no great distance below upon those of the schist formation. Nearly opposite the village of Mopani the following section commences, with what is here the lowest rock of the formation.

A conglomerate of a fine, green, earthy base, which is slightly calcareous in places, and the pebbles of which are exclusively derived from old crystalline rocks—this passes up into a coarse soft sand-stone, which in places contains many pebbles, though not quite a conglomerate. A remarkable trap dyke cuts these rocks just here—it is 50 feet thick (wide.) Where it is shown in the stream, there are several off-shoots running parallel to the mass, and presenting with the portions of sand-stone and conglomerate caught up by them—many finely seen instances of the phenomena of alteration.

Passing upwards there are thick and thin bedded sand-stones dipping to the East, at angles varying from 5° to 20°; these also contain bands of pebbles, and are alternated with some beds of greenish micaceous flag-stones. These are succeeded above by an alternating series of shales and sand-stones; the shales are dark-colored, hard, fine-grained, though arenacious, and contain carbonized impressions of reeds. In one or two cases there is among these shales a trace of coal. One little bed, 6 inches thick, is found in the South bank of the stream, but does not appear on the other side. There are some bands of soft blue shales and some of soft grey micaceous sand-stones, interstratified with thin partings of coal.

On these rest a bed of coal dipping E. 35° S. at 25°, and measuring 5 feet, of which a foot at top and bottom seem impure, leaving about 3 feet in the centre of excellent coal.

Hard blue and grey shales of varying thickness.

Sand-stone.—A pale yellowish grey rock, worked here for flags; in places contains much mica; it is 30 feet thick and dips E. 25° S. at 25°.

Shale.—Grey and hard, 10 feet thick, dips E. 35° S.

Coal.—10 feet thick, looks *very promising.*

Sand-stones.—Grey, thick-bedded, including bands of red and blue shale 50 feet thick, dips E. 5° N. at 15°, and with these ends the section in this direction, as they are covered by a series of conglomerate beds, which I have not succeeded in tracing to any satisfactory connection. A small fault displaces the out-crop of the coal beds and exposes four places in the stream, which have been mistaken for evidence of the existence of 3 beds. There are really however only 2 in which, including the whole thickness of the lower one, where I measured it with the impurities there noticed, we have 15 feet of coal, in two beds well exposed in the banks of the stream and dipping at angles varying from about 20° to 25°.

From the lower bed were taken those specimens of coal sent to Bombay under the name of Benar coal, and which, in spite of the unfortunate result of the experiment, were so greatly praised by the dock-yard authorities there. At the out-crop it looks poor, but of good promise notwithstanding, for the bad qualities seem to be rather the result of deterioration from atmospheric causes than of original admixture of impurities during deposition.

In 1849, it was stated in a Report addressed to Lord Faulkland, by J. Lushington, Esquire, "that in consequence of the difficulties met with in "transporting coal from this place to Bombay, the fuel was so smashed up "and mixed with foreign substances before it reached the dock-yard, as to "be quite unfit for use until carefully cleaned."

It has been found to coke well; it seems remarkably free from sulphur. Although at the out-crop it crumbles readily, yet, at a slight depth below, there is reason to think, that it may prove capable of packing well, nor do I believe any coal could have been with impunity submitted to the trial, which the Benar coal had to undergo in its journey to Bombay.

The dip is rather high, and there is some reason to anticipate that water may prove troublesome in the working. This may probably be at

first, at least guarded against by working from the out-crop to the East, along the strike horizontally, as the ground rises in that direction, the beds being seen just under a spur of the general range, which stretches a little to the North just here. As some set off, too, against inconveniences likely to arise from drainage, the stream offers a water power, which may I think be made available. The spot is easily accessible from the great valley, above which it is a little raised. The difficulties of constructing a road are slight, and although as long as the difficulties alluded to by Mr. Lushington, existing in the absence of all means of transport, are still extant, it may be impossible to make the coal from here pay its expenses in a market so distant as Bombay; yet, if any demand were to be created in the Nerbudda Valley, or any means of carrying the fuel to greater distances found, mining operations could, without doubt, be profitably carried on. In the event then of a railway, which would furnish both a demand and a means of transport, this place must prove a valuable source of coal.

Tawa Nuddee.

In the bank of the Tawa Nuddee, where it leaves the hills, there is exposed, under the old fort of Bagra, a section, showing a fault which here brings the coal-bearing conglomerates into contact with the lime-stone of the schist formation. This conglomerate seems to be the same which at Mopani lies at the bottom of the coal-bearing series there, and here the fault seems to be of small amount and probably very local. Above come beds of the typical coal-bearing sand-stone; the dip is irregular and rolling; the beds thin out, and there are some bands of shale; but *no coal appears in a position relative to the bottom conglomerate corresponding with that in which the Mopani beds are seen.*

On entering the area drained by this Tawa River farther to the West by the Patroda Pass, the sand-stones are seen to rest on the schist rocks, without the intervention of the conglomerate, as far at least as I explored that part of the boundary. There are three principal tributaries of the Tawa, the Suktara, the Bhora, and the Sukni, which drain the undulating table-land lying within the Northern escarpment of the Goandwarra hills. In this part of the District they flow towards the East on their way to join that stream, and expose many sections of the coal-bearing rocks. These, when taken together, show that the sand-stone has a variable and rolling dip, and is cut through by trap in many places, which often overflows considerable areas. This trap does not violently

disturb the sand-stone, and seems to alter it only where in absolute contact therewith, never extending its influence many inches. The succession of the beds is so often broken by the trap, and the direction and amount of the dip so various, that it is impossible to estimate the thickness of sand-stone exposed in these sections—perhaps even the closest examination may fail to give certain results.

The Bhora Nuddee, at Sonada, shows the out-crop of two little beds of coal, which, whatever may be the aggregate thickness of the sand-stones of the District, lie at or near the bottom of it. These, Mr. Johnson states, to be 6 and 7 inches thick respectively, but he excavated all that could easily be taken away from the out-crop, and the stream has since then filled up the hollows made, and thus very little can now be seen of these beds. He found 18 inches of coal in a pit which he sunk on the East bank of the stream, which gave fuel of good quality, but his pit is filled with water far above the level of the coal, so that I failed to see it either. However, the cost of transporting this coal on the backs of oxen for more than 100 miles, before it reaches the water carriage of the Nerbudda, seems to have put a stop to Mr. Johnson's attempt. The first 30 miles are over an exceedingly bad road. Possibly, if a demand existed at Lokurtullie, Sewni or Herinkaire, a road might be made, and the mines made to pay, though most probably, if any working existed at Mopani, the superior advantages of that place would be sufficiently great to render any attempt here unprofitable.

It may also I think reasonably bed oubted if boring throughout the valley will ever bring to light any more promising locality than that opened by Mr. Johnson at Sonada. From what I have above stated of the area occupied by the coal-bearing rocks in this neighbourhood, it will be seen that, did such better bed of coal exist, it might naturally be expected to appear at the surface. Under the circumstances I have described the disturbances caused by trap, the changing nature of the dip of the sand-stone, and the many sections exposed by streams, which, running in all directions, drain the table-land and valleys of the coal-bearing rocks, still the District has been examined by Colonel Ouseley, Mr. Conebeare, Mr. Johnson, and by me, besides many geologists, who have left only traditionary records of their researches, and yet no out-crop of coal has been found so good as at Sonada. All this is of course not conclusive, but will I hope satisfy you that the prospects here are not very brilliant, nor do I think much encouragement is suggested by the general aspect of the rocks.

In order to place before you some means of judging of this, I shall now give you a somewhat detailed account of the section seen near the junction of the Sukni Nuddee with the Tawa. In the former stream the place is mentioned by Mr. Johnson as suggestive of the hope that trials throughout the field may be successful in hitting on coal; but as I say I think an examination of it is calculated to produce the contrary impression, it is characteristic of the District.

From the Tawa Nuddee up the course of the Sukni towards the South and East—

	Descending Feet.
No. 1.—A coarse, soft, greenish, earthy and slightly micaceous variety of the coal-bearing sand-stones, containing little nests of coal, dip. N. 10 W., ...	—
No. 2.—Coal-bearing sand-stone, with threads of carbonaceous matter, includes a lenticular mass of thin bedded green micaceous sand-stone, which thins out and disappears, dip. N. 15 E. to N. 15 W., ...	20
No. 3.—A set of thin-bedded sand-stones, green, earthy, and micaceous, along some of the partings carbonaceous and on others ferruginous markings. These thin out towards the East, where No. 2 is seen to rest on No. 4, dip. N. 30 W., ...	8
No. 4.—Coal-bearing sand-stone, with threads of coal and little veins of carbonate of lime—in parts the mass will effervesce with acid, ...	—
No. 5.—A set of irregular beds of shale and earthy sand-stone; here occur the larger nests of coal. One, the best I saw, measured 2½ inches in the thickest part, from which it rapidly thinned out, and was lost among the false bedding of the sand-stone within 4 feet horizontal. There is also a bed 6 to 8 inches thick of dark-colored shale, one or two of the laminæ of which might perhaps be called coal, but these never exceed 2 inches in aggregate thickness and are soon lost in the shale,	—
No. 6.—Thick bedded coal-bearing sand-stone, with many threads of coal and patches of shale, ...	—
No. 7.—Coal-bearing sand-stone, with veins of carbonate of lime, dip. N. 15 E., ...	—
No. 8.—Earthy thin-bedded sand-stone, micaceous, soft and decomposing in the low bank of the stream; these contain the two best bands of coal, seen 3 and 2½ inches thick respectively, and apparently continuous; there are also a few beds of dark-colored shale, ...	10 or 12
No. 9.—Coal-bearing sand-stone, ...	10

Descending Feet.

No. 10.—Blue and green sandy shales and earthy micaceous sand-stones, thin-bedded traces of coal, dip. N. 10 W., ... —

No. 11.—Coal-bearing sand-stone, with threads of dark grey micaceous shale, and some veins of carbonate of lime, ... —

No. 12.—A series of thin-bedded sand-stones and common coal-bearing sand-stones, which pass down into a green mud-stone; itself seem to rest on the granite near Loharpur village, situated several miles to the West and South up the valley of the Sukni and near the foot of Bowergurh hill, ... —

With regard to the thickness of the different parts of this section, though I measured all carefully and endeavored to estimate irregularities fairly, yet I cannot venture to set down figures, which could only mislead; but I have already drawn your attention to this subject on the occasion of a former measured section which I have given. Balancing then the causes of error as well as I can, I believe that the aggregate thickness seen in this place may be stated as a little under 200 feet, exclusive of the green mud-stone, which, showing scarcely any traces of bedding and being cut by the trap in several directions, it is quite impossible to estimate. It forms the underlying rock of the formation at (this) the only place where the boundary of its South limit was reached by me. A closer examination of the country may no doubt give data for estimating thickness and other points, which I call impossible; but you will remember, that your instructions did not encourage me to spend time in trying to throw light on the structure of the country, where it was not more immediately connected with questions commercially important. With reference to the threads of coal mentioned by me in the above section, they seem to be caused by very thin accumulations of carbonaceous matter formed between some two layers of the false bedding of the sand-stone, and which, from the soft texture and irregular wearing of the surface of that rock, trace their little out-crops over it in waved threads. I need scarcely add that the *coal* here is perfectly useless.

As far as my present acquaintance with the structure of this coal field gives me any ground for an opinion, I believe that there is some reason to think that these traces of coal, shale, &c., as well as the sand-stone beds, have nearly the same relative position in the formation as the Mopani coal, and may so far be said to represent it; and thus, although in this part of the District the hope may be slight of finding any good beds of coal, yet the country to the East may reward our future exami-

nation, with the detection of a more valuable representative of the coal-bearing part of the formation—meantime there is at Mopani a locality well worth the notice of any one who wants coal, and the exploration of which would repay the labour expended, if only a market be found within some reasonable distance of the place, or some means of transport, which would overcome the obstacles which now exist in the absence of roads and the impracticable navigation of the Nerbudda.

Iron.

The geological association of the iron ore deposits of the Nerbudda Valley, looked at generally, seems to connect it with the line of disturbance which has determined the escarpment of the hills along the North side of that valley. These deposits seem to rest on a bed of highly altered sand-stone (quartzite) or on a peculiar quartz-breccia, which is seen in many parts of the same line, and to lie under the lime-stone of the schist formation. This is a fair statement, as far as the often nearly vertical position and general disturbance, to which the rocks have been subjected, permit such relations to be positively and definitely stated. Moreover, the trap comes out among and covers the older rocks so frequently along the above-mentioned line, that nothing is really added to the " history of the conditions," by stating that that rock seems always to appear near where the iron is seen. The line alluded to almost always lies on the North side of the river: on it stand Panagurh, Tendookhera, Bamber, besides many other localities where workings exist, and many more from which ore has never been extracted. There are it is true places in the valley where the ferruginous lands of the coal-bearing rocks have been, and are, used as a source of iron, such as the neighbourhood of Gungye (South of Nursingpore,) but this and other similar places are insignificant when compared with those situated as above described. In some places these ferruginous bands of the coal-bearing rocks contain a rich ore, though they are seldom thick, and still more seldom look as if you could count on their maintaining the character which they have at any one spot, far in the direction of their horizontal extension; still when the coal beds at Mopani and elsewhere come to be worked, the extraction of iron-stone in connection with coal may perhaps be looked forward to as a source of profit. *The* iron deposit of the valley is however geologically confined to the line above pointed out, and as far as my examination of several points along that line

may justify the opinion, I believe that no doubt need be entertained of the abundance of the supply. At first I believed that the iron ore deposit was of an origin more recent than the rock with which it is associated. Though this is true of those masses of detritus and gravel used in many places for smelting, a more extended and closer examination of the sources, from which the gravel and detritus themselves are derived of the rock *in situ*, has led me to question the truth of my former belief, and to conclude that the weight of evidence so far is in favor of the syn-chronisia of origin. This is however of less importance than the fact of the actual abundance of the ore, which is indisputable, especially in the neighbourhood of Chandgurh and Bamber. I shall now describe the different localities which I have visited.

Tendookhera.

The town of Tendookhera stands in the flat of the Nerbudda Valley, about a mile from the Northern escarpment, and on the black soil which covers those fertile plains. The mines are situated at about 2 miles to the South-west, nearly under a long low hill of lime-stone. I was surprised not to find the workings more extensive, although they are far more considerable than any I have since seen, and to find that the ore is extracted almost entirely from open quarries. After cutting through about 20 feet of the red and yellow clay which here underlies the black surface soil, the vein or bed is reached. From the very surface however indications of its presence may be traced, and through the clay a vast number of fragments are scattered, small in size above and gradually increasing with the depth. On the North side, that is below, for the dip is towards the South, the deposit seems to rest on a siliceous rock, fragments of which not only occur with those of the ore, scattered through the clay at that end of the workings, but the ore itself is apparently associated with a siliceous matrix; whereas towards the South it is evidently calcareous, and still farther in that direction the lime-stone is largely developed. In the pits indeed I did not see the siliceous rock *in situ*, whereas the lime-stone is prominent; and from the great amount of fracture and disturbance to which its beds have been subjected, it is not easy to determine whether the deposit of iron ore may not be positively interstratified with it, or whether the ore may not have been accumulated in the cavernous hollows in the lime-stone beds at their out-crops, or lastly, whether a single bed of the ore, originally lying between the quartzite sand-stone below and the lime-stone above, has not been faulted, so as to assume the ap-

pearance of interstratification with the upper rock. Looking on what I saw at the Tendookhera mines, by the light thrown on the question by an examination of other localities, I prefer the last of these explanations—I believe it fits the facts, though some evidence does appear in favour of either of the other suppositions. The mass of the ore is exceedingly hard and tough and difficult of extraction; the slight soft picks used render it a work of immense labour to detach fragments from the mass, and a very great waste of labour is incurred, by the way in which the produce is raised to the surface. Water readily collects in the pits, and no pains are apparently taken to avoid the falling in of great flat blocks of the lime-stone, which they leave unsupported, and which accordingly not only shut up some of the most productive burrows now and then, but have more than once caused loss of life. The ore, which is of a very mixed character, though almost every where rich, is principally earthy brown and red hœmatite; here and there masses of specular iron, apparently united in the same general aggregation, are seen: this variety is very heavy, after a fine steel grey, metallic looking ore, weathering red. The produce of the mines is carried in carts, but I am informed principally on the backs of oxen and buffaloes, to the town, where it is smelted; at present the scarcity of fuel is very severely felt, charcoal being brought from great distances; Mr. Jacob states 36 miles; I did not, at the place, hear more than 10 miles mentioned. It is however far more costly than at any other place where iron is worked in the District, and yet though precisely the same process is followed everywhere else, the iron from the Tendookhera furnaces undersells the Poonassa iron at Poonassa itself and to the West at Indore, Mundlaisur, &c. Lieut. R. H. Keating, in his Report to Sir R. Hamilton, dated March 1854, states that he considers this circumstance to be due to the bad way of working followed at Poonassa, but I think it cannot be so explained. Men have more than once been got over to Poonassa from Tendookhera, and I think no difference worth noticing can be seen in the manner of working in the two places. The secret I believe lies in the lime, which is involuntarily taken out of the pits at Tendookhera, along with the ore itself, frequently so strongly impregnated as to effervesce with acid, a peculiarity which I have never found in the ore taken from any other locality which I have visited.

Although the general geological position of the iron deposit at this place is the same as at Bamber and Chandgurh diggings, whence the

ore for the Poonassa furnaces is obtained, yet, from the circumstances of the faulting and crushing of the beds of lime-stone, when the ore is here extracted, from infiltration taken in connection with these or from other causes which I have failed to trace, the mass of the ore at Tendookhera, especially towards the South side of the little area worked, is as stated impregnated with lime.

Chandgurh and Poonassa.

The diggings near Chandgurh, which supply the Poonassa furnaces, are small burrowings spread over a considerable area. They there work only a gravel composed of pebbles of rich heavy ore, and as this deposit is thin, they soon exhaust the supply obtainable from any one spot. I did not here see a pit more than 4 feet deep, nor could I find that the ore *in situ* was ever reached, though I believe it to be at no great distance off. This iron gravel does not by any means cover the face of the country, but seems confined to irregularly distributed patches, spread principally along the lower slope of the little range of hills which here represents the great escarpment. To the North and East from these diggings are many other localities, where ore is being, or has been, extracted, but by far the best of these is near the village of Bamber—at that place both the gravel deposits and the ore *in situ* are worked, the former principally, from the greater ease with which it can be removed. It occurs here precisely, as at other places in the neighbourhood, lying near the surface, in the slight depressions of the older rocks and filling the inequalities worked into them by denudation. It is frequently agglutinated into a very hard tough mass, by red ferruginous clay; the fragments are seldom much rounded, often perfectly angular, and in some places adhere to each other with very little of the clay cement.

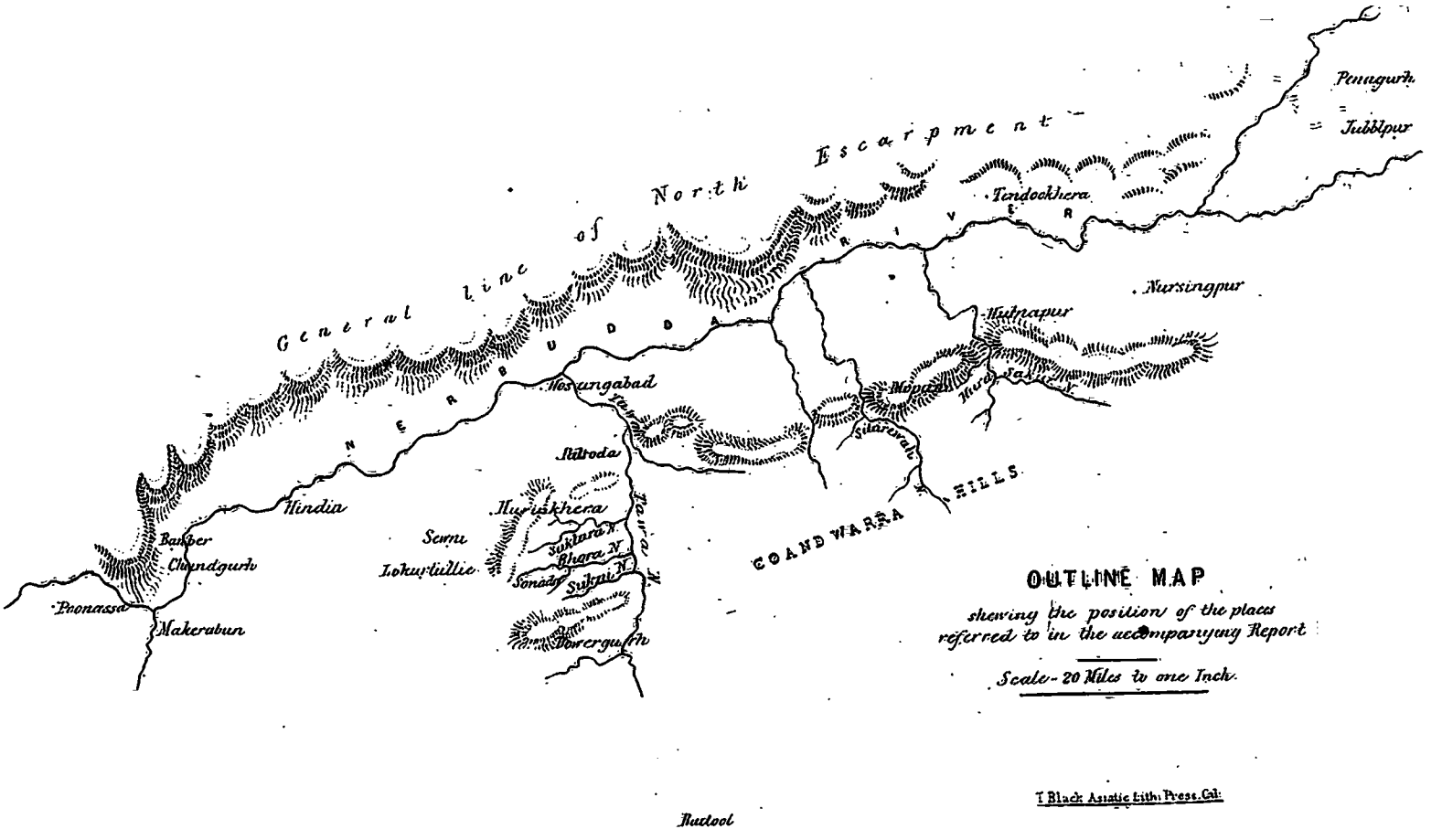
The ore *in situ* worked here is very rich indeed; it is almost exclusively fine specular iron ore, with a clean metallic lustre on the fresh surface, and bright red streak. Unlike that at Tendookhera there is little mixture, and the bed or vein may be traced for miles, holding along the general strike of the lime-stone beds and the altered sand-stone. In several places where I crossed its out-crop, it seems at least as good as where they work it.

At Bamber, 2 miles from the mines, there are four furnaces; at Karia, 6 miles off, fifteen or twenty; at Baline, 3 to 5 miles off, six or eight; and I am informed about as many more smelting villages, in different directions, are all supplied from the diggings here. This is decidedly the most

prolific source of iron that I have seen in the valley, and seems to me to offer a supply of material practically unlimited. It is not possible with present information to make such an assertion of Tendookhera, for the out-crop of the iron bed there is hidden in both directions. Supposing it to continue, as here, along the strike of the lime-stone and quartzite sand-stone, a few trials would of course answer that question whenever it becomes desirable to do so.

In conclusion I have a few remarks to make on Mr. Jacob's Report, into the statements contained in which you instructed me to examine. Of its general accuracy there is no doubt, and as far as I have seen, I can confirm most of his views and conclusions. Some points, however, would seem to be questionable. He recommends Poonassa as a desirable locality for establishing iron works, but seems to overlook some facts, which seem to me of considerable importance—one is that the ore used there has to be brought from the Chandgurh diggings, a distance of 15 to 20 miles,* including a passage of the Nerbudda at Sukni Ghât, where the bags of ore are taken off the carts at the top of the high rocky bank, carried down to the boats to be ferried over, and then conveyed up the opposite side and placed on carts, which deliver them at Poonassa. Again, the charcoal is by no means so easily had as on the North bank. Whether the very great increase of expense thus entailed is not counter-balanced by the four reasons given by Mr. Jacob, as influencing him in favour of Poonassa, I cannot pretend to determine, but I think the question worth re-considering. He says, *first*, Poonassa is in British territory; *second*, soil fertile, place healthy, water abundant; *third*, conveniently situated for trade, lime-stone close by; *fourth*, North bank is unhealthy from dense jungle. Of the first I have nothing to say; second, whether the fertility of the soil may be of material importance, I don't know, but think not—it is most true that the North bank is covered with dense jungle and might prove unhealthy, at least during the rains—I doubt however if Poonassa itself be a much more salubrious locality; *third*, Poonassa *is* I suppose more conveniently situated for trade, but the question ought to be, whether the conveyance of *manufactured* iron to any trading town on the South side to Poonassa itself, from places to the North of the river, would prove a geater disadvantage than having to convey the raw material similar distances as now done.

* Mr. Jacob says 10 miles, and does not allude to the passage of the river.



OUTLINE MAP

shewing the position of the places referred to in the accompanying Report

Scale- 20 Miles to one Inch.

T Black Asiatic Lith: Press. Cal:

Mr. Jacob I think looks too favorably on the resources of the "friable ore" or gravel deposit and over-estimates both its superficial extent and depth, for though no doubt "hundreds of acres" are covered by it, yet the radius must be long that will, with Poonassa, as centre, include a large area of it. No doubt Makerabun is an inferior locality, yet if the ore *in situ* could be traced there, it would obviate most of the objections I have to make against Poonassa as a smelting locality; being so much nearer than the diggings which at present supply that place and on the same side of the river.

You will have seen, by what I have already stated, that I take a less sanguine view of the prospects held out at Sonada, and in that part of the coal field than he does. I cannot look on the out-crop than as "indicating a rich mine beneath." I fail to perceive on what grounds Mr. Jacob says that the available coal fields measure 15 miles by 7. They are here more than 15 miles broad from North to South, and towards the West from Sonada they are known to extend at least 150 miles. At Benar he mentions three seams of coal, I saw only two; nor do I think the figures he gives agree with what I saw on the ground; but without noticing what may fairly be called less material points, as far as I have been able to form any fixed opinion, I agree with many of those he expresses, and quite coincide with the favorable view he takes of the mineral resources of the valley as far as coal and iron are concerned.

(Signed) H. B. MEDLICOTT.

Sagur, 14th June.

NOTE.—In the foregoing pages, the terms "coal-bearing" or "coal measure" will have been used, simply as conveying the expression of a certain mineral or lithological character, and not as in any way intended to identify the rocks referred to with the carboniferous epoch of geologists. This question must be determined on other evidence.

No. 34 A.

To

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India.

SIR,

I BEG to forward herewith, for submission to the Hon'ble the President in Council, a Report on the results of my examination of the coal fields of the Tenasserim Provinces during the past season.

In accordance with the instructions of the Most Noble the Governor General in Council, I have endeavoured, within the limits of one season, to form a fair opinion as to the real value and relative importance of the various places where coal is found in these Provinces, and this I have stated in the accompanying remarks.

Our labours were carried on under circumstances of fatigue and exposure, such as few Europeans are subjected to in this country. Owing to the total absence of roads, I had to move about in boats, and frequently in canoes of the smallest size, in which we lived for weeks together. Every supply, both for myself and the coolies, had to be, in all cases, carried with us, often for more than 100 miles. No local aid whatever could be obtained, for frequently there was no human habitation within many days' journey of the places visited. We had to cut our way through the densest jungle, and often climb the loftiest trees to get even an approximate knowledge of our position. It would be difficult to imagine a country less suited for any detailed geological examination. Our time also was short, and I believe we have done as much as was possible under the circumstances.

I am happy to be able to add, that by the exercise of proper precaution, I have been able to keep all my party in good health, notwithstanding their long exposure in the jungles.

From all the authorities in the Provinces we received most ready aid. To Sir Archibald Bogle, Commissioner, I am indebted for hearty co-operation, both previously to, and in anticipation of my arrival, and subsequently; while at Moulmein, the interest taken by Captain Haughton, the Magistrate, in geological pursuits, enabled him to anticipate our wants, and in the most friendly and zealous way to aid our pursuits. From Mr. Stevenson at Tavoy, and Mr. Chase at Mergui, I also received every assistance. Indeed, without the help thus so readily afforded, I should not have been able to accomplish so much as I have done; our

researches, though to a great degree partial, having extended over nearly seven degrees of latitude, or nearly 400 miles from North to South.

In consequence of my having proceeded to Pegu, with a view to the examination of the country about the Station of Thayet Myo, immediately on my return from the field in Tenasserim, some little delay has occurred in the drawing up of this Report, which was under the circumstances unavoidable.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,
Supdt. of the Geological Survey.

Amarapura,
The 1st September 1855.

NOTES ON THE COAL-FIELDS AND TIN-STONE DEPOSITS OF THE TENASSERIM PROVINCES.

THE Tenasserim Provinces extend along the Eastern shore of the Bay of Bengal, from the harbour and river of Moulmein on the North to the Pakchan River on the South, embracing a sea-board of more than six degrees of latitude. In breadth from West to East, their extent is nowhere very great, seldom much exceeding one degree of longitude. The Eastern boundary, which separates the British territory from the dominions of Siam, is but little known, and is, for the greater portion of their extent, formed by an interrupted range of mountains, which in part rise to peaks of between 7,000 and 8,000 feet elevation, but the average height of which does not exceed 4,000 to 5,000 in the Northern portion of the Provinces, diminishing to 3,000 and even less in the more Southerly Districts. The main direction of this range is North and South, and the direction of the coast line corresponds with this, for the Northern portion of the Provinces but trends gradually away to the East in passing Southwards. The prevailing direction of the minor ranges of hills, and consequently of the rivers, is also meridional.

The Provinces are divided into three Districts, of which respectively Moulmein, Tavoy and Mergui are the principal towns, all placed on or near to the sea-coast. In the last of these Districts, Mergui, which is also the most Southerly, are situated the coal fields referred to below.

In general geological structure, the Tenasserim Provinces appear to be tolerably simple, although the relation of the rocks at first prove very deceptive, owing to the numerous dislocations and disturbances to which they have been subjected. Resting upon granite, a series of highly metamorphosed rocks occur, exhibiting every variety from perfect gneiss and mica slate to hard siliceous slates, occasionally chloritic, and to black earthy, but micaceous and glossy slates. Through these numerous veins of granite penetrate and ramify in every direction, and of all sizes. These are only seen near to the immediate junction of the granite and the bedded rocks, and where this junction is not absolutely traceable, the occurrence of similar veins points, I think, conclusively to its close proximity.

Resting upon these, there is (in the Southern portion of the Provinces at least) a great accumulation of beds of a pseudo-porphyritic rock, deriving this aspect from imbedded crystallian fragments of felspar, which weather out freely or become whitened on exposure. In its most normal character, this is an earthy, but highly indurated rock, with these small irregularly disseminated bits of felspar; but this passes by almost insensible gradations on the one hand into hard earthy slaty masses without their disseminated particles, and on the other into grits, containing much rounded fragments of quartz, quartzite, and of these pseudo-porphyritic rocks themselves. These grits often become very coarse, and largely conglomeritic. The interculation, and occasionally regular succession of these varied deposits, renders the bedding of the series traceable, but the rocks have been subjected to very great disturbances, and are found dipping in every direction and at all angles. These rocks form all the higher grounds of the outer ranges (as distinct from the central range of mountains dividing the British territory from Siam) in the Southern portion of the Provinces, but are only feebly represented in the Northern portion. The general character of the series also varies materially in different parts of the Southern Provinces, the greater or lesser prevalence of grits and conglomerates and of hard sand-stone beds affecting the general aspect.

With this group of rocks, and resting upon it, appear to be associated a considerable thickness of dark-colored blueish and blueish-black earthy beds, frequently thinly laminated, and then presenting an imperfectly developed slaty structure. With these occur some beds of very hard, generally dark-grey, quartzose grits. In parts, apparently from a

greater amount of local igneous action, these slates become silky in aspect and much crumpled. These must be of considerable thickness, although their immediate relation to the rocks occurring close to them are obscure. Taking them in connection with the pseudo-porphyritic rocks, and the conglomerate and grits below, the total thickness cannot be less than 9,000 feet. To these rocks, as being best seen in the Province of Mergui, in all their varied character, I would apply the distinguishing name of the "Mergui" series.

These are succeeded upwards by a group of hard sand-stone beds, often in thick and massive layers, with thin earthy partings—often in thin laminæ, finer and more earthy. The prevailing colour is of a reddish tint, or reddish white tint, but some of the beds are of a deep red, and others of a yellowish earthy tint. A few of the layers are slightly calcareous, and in the upper portion a few thin and irregular bands of earthy lime-stone of a blueish tint occur. In some of the softer and more earthy beds fossils occur *(Corals, Gastenpoda, Brachiopoda, Crustacea,* &c.*)* Over these sand-stones another series of grey shaly beds occurs, these are occasionally calcareous, and when so, yield fossils *(Spirifera, Producta,* &c.,*)* and also pass occasionally into a soft black carbonaceous mass, with nodular concretions of hard quartz. Some beds of sand-stone, often of a dark colour, are associated with this group. Above these come a series of no great thickness (150 to 200 feet) of fine soft sand-stones, thinly bedded, and with grey and pinkish-colored shaly layers intercalated; and upon these appears to rest the hard and thick lime-stone of the District, as seen near the Tenasserim River and in the Southern part of the Provinces. This lime-stone is the representative of the great lime-stone which is seen so largely developed near to Moulmein and in the Province of Amherst, but which is, comparatively speaking, sparingly present in the South. Its relation with any overlying rock I cannot state.

The whole of these form one continuous series, and as some of the most important members of that series are best seen in the immediate vicinity of Moulmein, I would designate the group the "Moulmein" beds.

These Moulmein beds, and down in the succession I have given to the top of the Mergui group, appear to me, so far as I can at present judge, to represent the same general geological epoch as the lower carboniferous group of European geologists. The era of the "Mergui" rocks them-

selves is not so clear. In many cases, pseudo-porphyritic beds have much the aspect of some of those curious and interesting igneous masses, which are so common in the Siberian Districts of England; while others of the coarse and hard, and often almost corneous sand-stones and conglomerates have all the lithological character of many of the European Deomian series; but as yet their lithological character is the only evidence, as I could not trace any organic remains which could give a clue to their geological epoch—I have given their average thickness above as 9,000 feet; but when most largely developed, they are at least 11 to 12,000. The total thickness of the "Moulmein" group above, exclusive of the lime-stone, is about 5,000 feet, and the lime-stone itself (near to Moulmein) has a thickness perfectly seen of some 1,100 feet.

This lime-stone is by no means deficient in fossils, but is, in general, so hard and compact, that it is entirely impossible to get any of the imbedded organic remains out. On the weathered surfaces, and smooth water-polished faces of the rock, their outlined sections can be traced, worn down perfectly smooth with the general surface, but any attempt to break them out inevitably results in the fracture of all. In the caves near Moulmein, hundreds of these can be seen, and I can scarcely fancy how many previous observers can have repeated the statement that this lime-stone was non-fossileferous. Probably, if this rock were any where quarried, some of these organic remains could be procured, but unfortunately, here as elsewhere, one of the great difficulties a geologist has to contend with is the total absence of any openings or quarries into the rocks of the District.

Upon the denuded surfaces and edges of the rocks hitherto described, we find a series of beds of conglomerates, of sand-stones, of soft and loosely coherent shales, and of *coal*, which stretch at intervals over a very large portion of the Southern part of the Tenasserim Provinces. The conglomerates are never very coarse, the pebbles seldom exceeding a few inches in diameter; the sand-stones are fine gritty and pebbly, clean white quartzose sands, or earthy and of a yellowish tint; the shale beds are of a blueish-green or blackish tint, and very regularly disposed in thin and frequently repeated laminæ. The coal itself is also regularly disposed in thin flaky laminæ, with minute earthy streaks marking its structure.

Besides their unconformability with the lower rocks, and the difference in mineral character which these beds offer, there is a total difference in

their imbedded organic remains. In some of the layers of the soft sand-stones and shales numerous impressions of dicotyledonous leaves are found, of a very recent aspect, and in the beds of papery shale which accompany the coal (like much of the papery brown coal of Germany) are numerous fish scales and bones (but seldom any thing like a perfect fish) of fresh-water character. All these circumstances combined point to a very recent geological epoch for the formation of these beds, and I have no hesitation in entirely agreeing with the opinion on this point formerly expressed by Colonel Tremenheere, that these coals are of the tertiary period of geology. The reasoning which led the "Coal Committee," in their Report for the year 1845, to arrive at a different conclusion, I cannot follow. "There cannot, however, be a doubt as to its belonging to "the true coal formation, both from the nature of the coal itself, as well "as of the beds with which it is associated," is the statement of the Committee (page 137,) but the usefulness of lithological character alone to determine the geological age of any rock is well known.

It is an interesting and curious fact, however, that in this District there is a very considerable development of rocks, which, from their imbedded organic remains, are certainly of an age somewhat synchronous with that of the great "carboniferous" formation of geologists, but in which no beds of coal occur; while thick masses of vegetable matter have been deposited, and have subsequently been mineralized into good coal, at a comparatively very recent period. This is only an additional instance of how local all such deposits must be, when compared with large areas, and of how the altered circumstances of each locality must most materially affect the nature of the rock formed there at any given time.

These coal-bearing deposits, the total thickness of which nowhere exceeds 900 to 1,000 feet, are never traceable continuously over any very extended area. They are cut off and seem heaped up against the projecting ridges of the higher grounds and appear to be divided by these natural barriers into a series of isolated and detached portions. In all cases the physical conformation of the country now existing, or a conformation very slightly differing from that now existing, appears to have determined the extent of these deposits, and looking at the general nature of them, and of their associations, I am led to view them as a series of lacustrim (fresh-water) deposits formed in small lake-like expansion along the lines of the great drainage valleys of the country, wherein the waters became ponded back by natural barriers. These deposits also preserve a certain

general direction, and thus mark the line of a great depression, or general valley, between the main dividing ridge which here separates Siam from the British territories and the outer ridges which come between them and the sea. Through and across the line of this outer ridge, the general drainage of the country is discharged by a series of gorges or narrow rocky channels through which the main rivers pass. At Henzai Basin for example, many rivers, the general course of which is North and South, unite and discharge their waters through a narrow gorge of nearly a mile in length. The Tenasserim River, East of Mergui town, in a similar way discharges the large body of waters which had accumulated throughout its extended North and South course, together with the tributary waters of the Little Tenasserim and its affluents, through a narrow rocky gorge; and further South, at the Lenya River, the drainage of an immense area is all discharged through a narrow rocky gorge. All these gorges have a common direction nearly East and West, although the general drainage of the country and the course of the main stream is almost invariably North and South. It is this feature which gives rise to the remarkable and sudden alteration in the direction of these rivers, as may be seen by a reference to a map of the Provinces.

I have not attempted above to do more than merely indicate the general structure of the country, reserving all detail, until the organic remains collected during my visit have been carefully examined.

Passing now to a more detailed consideration of these coal deposits, and of their mode of occurrence, extent and value, I shall first give a list of all the places where coal was reported to have been found.

Previously to my visit to Mergui, Mr. Chase, the Deputy Commissioner in that Province, had been zealously engaged in getting together from the Burmese all the information he could regarding the existence of coal in any part of his District, and the localities where it occurred, and in otherwise making every preparation for my visit. In consequence of these enquiries coal was reported to him to occur in the following twelve places, of which six were then made known for the first time. Dividing these into groups according to their locality, as connected with the main drainage of the country, we have

On the Great Tenasserim River.

Thatay-hkhyoung, ... (Old coal field worked in 1843.)
Heiulap, ... (New.)

Kanmapying, ... (New.)
Bankyop, ... (Known before.)
Tagoo-hkhyoung, ... (Ditto.)
Banpyai, ... (New.)
Pawort, ... (New.)
Mauton, ... (Known before.)
Above the falls, ... (Mentioned by Dr. Helfer.)

On the Little Tenasserim River.

Tsing-koon, ... (Thian-khan of Dr. Helfer.)
Tagit-hkhyoung, ... (New.)
Nga-woon-hkhyoung, ... (New. This is a main branch of the Little Tenasserim.)

On the Lenya.

Near the head water, ... (Known before.)

Of these thirteen localities, in five, namely, Bankyop, Tagoo Creek, Banpyai, and Mauton on the Great Tenasserim, and in Tagit Creek on the Little Tenasserim, no coal exists; a black carbonaceous rock, with quartz nodules, which crumbles into powder on exposure and soils the fingers, having been mistaken for coal. Of the remaining eight localities, two only were not visited, that on the Nga-woon Creek, to reach which would have occupied so much time as to preclude my being able to visit other and more important places, and the statements regarding the occurrence of coal there were very doubtful, and the Pawort Creek was similarly of difficult and tedious access, while its position above some of the rapids of the Tenasserim River would render it almost impossible to work the coal to advantage, supposing it to exist, which however the structure of the District makes no doubt.

At the locality mentioned by Dr. Helfer "above the falls" of the Tenasserim, the seams were found only an inch or two in thickness, and extremely irregular in their occurrence and frequently discontinuous, so as to be practically quite useless.

There remain therefore *five* localities, namely, Thatay-hkhyoung, Heinlap, and Kanmapying in the Great Tenasserim, the Tsing-koon on the Little Tenasserim, and the Lenya, and these I shall notice in the order in which I have mentioned them.

Thatay-hkhyoung.—Thatay-hkhyoung or creek is the name of the locality of the coal mines which were worked by the Government to some

extent about fourteen years since. The pits were situated about three-quarters of a mile West of the bank of the Tenasserim, and close to the channel of a small stream which here comes down from the higher ridges to the West. The works were abandoned about 12 or 13 years since, and at the time of my visit, were, as was to be expected, filled with water. With some difficulty I was able to get this water reduced sufficiently to obtain a good view of the bed of coal on which the workings had been carried on, and then to examine its structure and arrangement.

The coal had been extracted entirely by means of open adits sunk on the dip of the bed and along the bank of the small stream, in the bank of which the coal was exposed. Shafts had also been sunk at a small distance to the dip of the out-crop and had reached the coal, but I was led to believe that coal had never been raised through them, the workings having been abandoned about the time of the completion of these shafts. Great expenditure had evidently been incurred here, a good broad road-way had been cut through the forest to the bank of the Tenasserim; this had been levelled by embanking and cutting (in one place a cutting of some hundred yards to the depth of nearly 12 feet,) and also in cutting a long and straight channel of the waters of the small stream, in order to divert them from the workings. Many experimental shafts were also sunk, in search of the bed of coal and of other beds beneath this one, but they appear to have been put down without any proper system, and were for the most part of great size and consequently very costly.

The section of the coal seen here was as follows:—

	Descending. Ft.	In.
Surface gravel and clay,	4	0
Stiff tenacious grey clay, with ferruginous markings and coatings on the fissures, which when cut follow the tool and give to the mass a red and ocherey aspect,	6	0
Brownish-black earthy scale, with fish scales and traces of vegetable remain,	5	6
The upper surface, and outer or exposed parts of this, decompose into a clay very similar to that immediately above. For a few inches next the coal it becomes more black—colour, finer shaly and flaky, and the remains of fish are more abundant.		
Rotten coaly matter and coal smut, ... 9 inches to	1	0
Coal, flaky, compact, highly shining coal; pyrites disseminated in parts; the laminæ often marked by extremely thin flaky partings, like thin black paper, and which retain in some cases a vegetable aspect or tissue.	16	6

This coal, taking it generally, has a total thickness of 11 feet 8½ inches, if in this be included all the small and thin partings of earthy matter which occur. In detail the section is as follows :—

	Ft.	In.	Ft.	In.
Coal, flaky and bright,	2	6		
Brown shale,	0	1½		
Coal,	0	4		
Greyish-brown shale,	0	1		
Coal, pyrites abundant, much more so than in the upper bed. This is good firm coal, becoming more earthy and flaky towards bottom,	2	0		
Blackish-grey flaky shale as soft clay, imperfect impressions of steam occasionally, thickness to	0	2½		
Coal, good solid coal pyrites on partings, rendering it "brassy,"	1	0		
Blackish soft coal shale, or earthy coal, shining and full of pyrites,	0	1		
Coal, rich flakes of jet coal of ½ inch, separated by earthy shales, pyrites abundant,	0	10		
Black shaly smut, with thin streaks of coal in it,	0	2		
Alternating and very irregular layers of flaky grey-black vegetable moulded of black jetty coal,	0	9		
Coaly shale, passing into coal,	0	8		
Alternating clay and coal in thin streaky laminæ,	0	6		
Grey flaky vegetable mould or clay,	0	4		
Black shale with coal streaks, some of ¼ inch thick,	0	10		
Grey clay, flaky, same as before,	0	5		
Shale, with thin bright streaks of coal, flaky and laminæ,	1	0		
	11	8½		
			11	8½

Under thin covers.

Greyish-white clay (under clay,) flaky and slightly sandy; small and imperfect remains of plants visible,			3	6
At bottom is more sandy and much harder; sand-stone much the same color and composition as the bed above, but more sandy,			0	6
Grey soft flaky clay,			0	3
Blackish ditto ditto,			0	2
Brownish-grey, sandy, clunch clay,			1	3
Clay, blueish-grey, soft and flaky, and very similar to that met before, in part,			3	0

Redder and more Ochray.

	Ft.	In.
Sand-stone, reddish white, close-grained and quartzose, with ochray stains; clay, hard, stiff, tenacious towards base, more ferruginous and sandy,.....	5	0
Sand-stone, ochray and quartzose, decomposing into a yellowish ochray sand,.....	4	0
	29	4½

The beds below this continue to be of a similar character, hard quartzose sand-stones for some depth, but no coal has been observed in them. Over all the beds noticed above a thick mass of conglomerate was found in sinking one of the shafts to the dip of the coal.

From the detailed section I have given above, it will be seen that the actual coal seams amount together to 6 feet 8 inches in thickness, while the intervening partings of shale, &c., only form an aggregate thickness of 4½ inches, so that the whole could easily be worked in one bed; and this was done.

The dip or inclination of all the beds is high, being as much as 28° towards 15° N. of E. There is a distinct jointing in the masses heading a little E. of North, at the planes of which underlie 60° at 70° to the West.

Throughout the whole thickness of the coal, iron pyrites appears, either imbedded in small lumps, or forming their crystalline coatings on the joints, often giving the coal, when freshly broken, a richly glistering metallic appearance. The coal, I was informed, turned out in good cuboidal masses, was easily wrought, and with little waste. It is difficult to ignite but burns freely, breaking up into small fragments, which do not intermine, or coke, and in large heaps requires care to keep up free ignition. It was found to answer well in the small steam engine used at the mines and also proved equal to ordinary "country" coal in sea-going steamers.

The presence of the iron pyrites mentioned above, to which, whether justly or not, was attributed the fact of some of this coal having spontaneously ignited on one or two occasions, would undoubtedly tend to render this coal unsafe; but I do not think that this alone would have been sufficient to condemn it, as this mineral is by no means constantly present, and much of the coal is so free from it as to be perfectly safe and useful. The waste at the mine would further be a productive source of alum, if economized in that way.

The rapid dip of the beds, and the consequent depth to which all shafts would soon have to be sunk to meet the coal, was, in my opinion,

and still remains, the most serious objection to the profitable working of this coal. In other respects it is well placed. The distance from the pits' mouth to the Tenasserim River is not more than three-fourths of a mile, and for the whole way a level road has been formed, on which it was intended to lay a tram-way.

At the time of my visit (February) the waters of the river were very low, though not at the lowest; but there was then, and I should think at all times of the year, a very tolerable supply in the small stream passing the coal pits. This could readily also be founded back above the coal and a reservoir formed, from which a steady supply could be obtained. The amount of water was quite sufficient for drawing a very effective water-wheel, and I am disposed to think that such would have been both a much cheaper and more useful process than simply diverting the stream as was done.

Heinlap.—The next locality on the Great Tenasserim River, in which coal has been found, is Heinlap or Heinlat. This is the name of a small scattered Burmese village, located on the right bank of the river, about 6 miles further North than Thatay-hkhyoung. The coal beds coop out at the Eastern side of a small mountain stream, about three-fourths of a mile to the West of the bank of the Tenasserim. The country between the river and the coal is at present an unbroken jungle, but it is tolerably level, and presents no real difficulty to the formation of an excellent road. The difference of level between the river bank and the coal, where it out-crops, is very trifling. The occurrence of coal here was made known to Mr. Chase, Deputy Commissioner at Mergui, by some natives who had seen it in their wanderings among the jungle. It was not known at the time of the works being carried on at the old mines, and indeed very probably was not then visible, as the stream may since then have cut away the bank and exposed it.

The section immediately at the coal gives the following succession :—

Blackish compact flaky shale or slate, abounding in small fish scales, bones, &c., same as those found at Thatay-hkhyoung, ...	4	0
Ditto, more pitchy-looking, with thin laminæ of bright coal, ...	0	6
Coal smut or dirty earthy coal, ... 6 inches to	0	9
Coal, flaky in structure; this separation into laminæ being well seen on exposed surfaces, but scarcely visible on the fresh fracture; the coal breaking as readily across these lines as along them; very thin divisions of more earthy and flaky character mark some of the layers; but do not occur in sufficient thickness or number to prevent the whole bed being removed.		

The coal is here not less than 17 feet 6 inches to 18 feet thick. From top to bottom of this splendid bed there is but little variation in quality, all is of good glossy aspect and conchoidal fracture, coming out in large and symmetrical masses, which do not, however, bear exposure for any length of time without breaking down. It burns freely, and with a good flame, does not coke, but breaks up, and leaves but little ashes.

Throughout the bed a few small lumps of iron pyrites, and a few thin coatings on the joints, occur, but not to any extent, and by no means so abundantly as in the coal at Thatay hkhyoung, or at Kanmapying, (to be described below,) nor do I think to any extent sufficient to prove objectionable in the use of the coal.

The specific gravity of this coal is 1·28, and by analysis 100 parts were found to contain

Volatile matter, inclusive of water, ...	54·6
Carbon, ...	45·4
Ashes, ...	6·5

The water was found to be 12·6 per cent.*

From this place, under the sanction of Mr. Chase, from 70 to 100 tons of coal had been extracted by a Burmese, and brought to Mergui, from which it was supplied to the H. C. Steamer *Pluto*, and proved a very effective and useful coal, keeping up steam well and easily fired. It is, as might be anticipated, of rather rapid combustion, and would be more adapted for tubular boilers than for those of the ordinary construction.

The coal was extracted simply by cutting back on the face of the outcrop, and in doing so only a thickness of about 13 feet of the coal had been touched, the rest being left as not so easily accessible. The cutting extended for about 7 yards in length, and had, therefore, not been carried to a depth of more than 12 feet. This was all filled on my arrival with water, and had to be all cleared before I could see the coal or its relations.

Under contract, the Burmese, who excavated here, received Rupees 24 for every ton of coal delivered at Mergui—a rate which, however desirable it may have been to encourage such undertakings at first, was very much too high to be maintained:—indeed the same man was most desirous of entering on another contract, for the delivery of coal at Mergui, at Rupees 16, or a reduction of one-third; but even this I consider was

* This analysis, and those given below, made by Dr. F. N. Macnamara, Chemical Examiner to the Government, are given on his authority.

too high a rate. Seeing, however, that in any case the amount of coal which could be procured in that way, without any machinery, or any of the most ordinary mechanical appliances, could only be small, and that every yard thus excavated was only tending to injure the mine, if any systematic workings were contemplated, I advised that such operations should be stopped, and no more coal has therefore been extracted.

Kanmapying.—Reserving for the present all consideration of a practical nature, I shall briefly describe the other localities. About three-quarters of a mile North of Heinlap another small village is situated in the jungle on the West bank of the Tenasserim, and within its lands coal has been found, exposed by the cutting back of a small mountain rill. This coal at Kanmapying is of very similar character and aspect to the others. Its analysis yielded to Dr. Macnamara the following results:—

Specific gravity, ...	1·33
Volatile matter, ...	54·2
Carbon, ...	45·8
Ashes, ...	3·5

The water included above in the amount of volatile matter was 10·5 per cent.

Iron pyrites is unfortunately very abundant in this bed of coal, and would render it an unsafe fuel for many purposes, from the danger of spontaneous combustion. For local purposes, however, it would prove a very useful fuel, the more "brassy" portions being rejected, and for such purposes a large amount of good coal might be here obtained.

It is not well seen, and the section is rather obscure. Covered by blackish shale, with some fish scales, &c., we have a bed or layer of slaty or lamina coal of 2 feet 8 inches in thickness. This rests upon a tough reddish-brown flaky clay, with carbonaceous partings of 11 inches; then a 2-inch seam of pale clay, with carbonized impressions of grassy stems; then 4 inches of carbonaceous and bituminous shale; then 1 foot 5 inches of ashy-colored clay, with carbonaceous markings. Under these is the main bed of coal, which here gives a workable thickness of about 8 feet, divided by some thin layers of earthy shale, but yielding large and symmetrical masses of coal.

This coal is at a slightly less distance from the river than that at Heinlap; the path through the jungle, cut nearly straight, is 1,090 yards in length, and over very easy and favorable ground. The points where it meets the river is, however, by no means so favorable as a shipping place near

Heinlap, where there is deep water and a firm solid bank held up by thick beds of conglomerate, which are here horizontal, and projecting from the bank, form in the dry season an excellent natural landing place.

Still further to the North, on the line of the Great Tenasserim coal, was reported, as occurring on a small stream, which comes from the West past the village of Pawort; but the story being very confused, the evidence very doubtful, and the distance said to be three day's journey up this nullah, which is only passable for the smallest canoes for one day's journey, so that the coal, even if it existed, would be practically inaccessible. I did not waste the short time at my command in visiting the locality—indeed I do not think it at all probable that any coal would be found there, judging from the general structure of the country.

Coal, as stated by Dr. Helfer,* also occurs at a considerable distance North of this and above the great rapids of the Tenasserim. This was visited by my colleague, Mr. Theobald, who found that it is in small nodular strings in the sand-stone, not more than an inch in thickness, and by no means continuous. These are, therefore, of no practical value whatever.

Little Tenasserim River.—The Little Tenasserim River joins the Tenasserim at the town of the same name, formerly the principal town of the Province. From its junction, its course is in a South-easterly direction and very tortuous for about 15 miles, when it assumes a general or North and South direction, but with many marked windings. At 24 miles to the South of Tenasserim town, or about 35 by the winding course of the stream, the waters of the Tsing-koon, a considerable stream coming from the East, unite with the Little Tenasserim, and to this distance the latter river presents no obstacle to navigation, being for a large proportion of the way subject to tidal influence.

The glowing descriptions given of the coal found in the upper waters of the Tsing-koon (or Thian-khan as Dr. Helfer spells it) had led Mr. Chase to incur considerable expense in preparing for my visit. He had himself, some two months previously, attempted to ascend the stream, but was stopped by large fallen trees, and had therefore despatched a party of men to clear the channel of the stream and to erect *zayats* or resting-houses at convenient distances up its course. Although the Burmans, judging of our rate of progress by their own very slow habits,

* Second Report, 1839, page 36.

had erected several more of these than were required, the precaution of having the course of the stream partly cleared was very essential. Even after all that had been done, it was in many places just possible to get through with the smallest-sized canoes: in some places channels had to be formed in the stony rapids, by turning all the men to remove the loose lumps and pile them up on either side, so as to form an *ex-tempore* channel, up which our canoes could be forced: in other parts they had to be lifted bodily over fallen trunks of trees—in some to be forced under those but slightly elevated above the water. In short it would be difficult to imagine a stream which could (for one-half at least of the entire distance) offer greater impediments to an easy and open navigation. Our boats were canoes of the smallest size, in which more than three men could with difficulty be put, and for any larger boats, it would have been altogether impracticable. No doubt during the monsoon many of these impediments would disappear, but if ever this Tsing-koon stream is to be made a highway for trade, a large outlay will be requisite to clear its channel in the first instance, and a considerable annual expenditure to keep it clear. This arises from its banks being composed throughout a great portion of its course of soft sandy clay and sands, thickly wooded to the very water's edge, with large and well-grown timber. The banks, being gradually undermined, many of these fall in during every season, and for a time most effectually close up the stream against the passage of any boats. Up this stream, accompanied by Dr. Chase I proceeded for five long days' journey (from Tenasserim,) and then leaving the canoes, marched about 11 miles further through the forest, until I reached the locality of the coal.

Dr. Helfer first discovered and described this locality in 1848, and then spoke of the coal in the following terms:—"A vein, 5 feet thick, "240 feet long, visible on the banks of the river, formation above grey, "below black clay slate, the lowest stratum apparently resting—to judge "after the general features of the country—upon blue lime-stone;" and again, "close to this, and a continuation of it, an immense coal field, of either "slaty or conchoidal pitch coal, or English cannel coal, highly bitumi-"nous, without any concomitant of iron pyrites." He states the seam to be in most places 6 or more feet thick, and dipping 25°. This locality is said to be 121 miles from Mergui, or from the town of Tenasserim 80.*

* Dr. Helfer's Second Report, Calcutta, 1849, p. 37, &c.

It is exceedingly difficult to understand Dr. Helfer's account of this coal, as he always speaks of it as cannel coal and pitch coal, and yet says it would rank next to Kilkenny coal, which is well known to be an arithracite, or in fact at the other end of the scale altogether.

The Reports of the Coal Committee in 1846 even went further than Dr. Helfer, and spoke of "inexhaustible beds of uniformly good quality" (p. 142.) I was therefore greatly disappointed, on coming to examine the place, to find that all these fine descriptions were, as far as I could see, quite unsupported by facts. There is undoubtedly a bed of what at first might readily be mistaken for coal, of 6 feet thick, and seen in more places than one; but of these 6 feet, there is in reality only a few inches of good coal; the rest is very earthy bituminous shale, with thin streaky laminæ of coal, barely sufficient to support ignition, and uncertain combustion; and even the coal, which does occur, is irregularly distributed in lenticular nodules or lumps imbedded in the general earthy mass, and having often very much the aspect of being the result of the thorough carbonization of masses of wood imbedded in the general heap of vegetable pulp and leafy mud.

There are two distinct beds, separated by an intervening series of sand-stone and shales of about 200 feet in thickness—of these beds, the upper one is decidedly the best, and from its total thickness (6 feet) I suppose that about 2 feet of tolerable coal could be obtained.

The detailed section of the coal beds and associated layers will show their character. The lower bed gives

	Descending. Ft.	In.
Clay and gravel on top, ... 10 to	12	0
Mould, blackish, ...	0	6
Ditto, red, ...	0	4
Coaly smut, earthy and ferruginous, ...	2	0
Coal, flaky, woody in structure, ...	0	4
Clunch clay, grey, flaky, with fragmentary vegetable impressions, abundant and irregular, thin streaks of bright jetty coal—lower 3 or 4 inches much lighter in color, ...	1	0
Coal, brilliant jetty coal, bright and glistening, in places 1 foot thick, but dying out to nothing within a few feet, and then again enlarging to 8 or 10 inches, very irregularly streaked with blackish shaly clay, ...	1	0
Grey clunchy clay, with many irregular seams of brilliant jetty coal, ..	8	0

Thus out of a bed or beds which on surface look like a bed of coal of more than 4 feet thick, there is in reality not more than 18 inches, frequently much less, of good coal, and this not in a continuous deposit, but in irregular patches.

At the upper bed the detailed section is

	Descending. Ft.	In.
Black coaly shale, ...	2	0
Coal and coaly shale, ...	1	1
Shales, brownish-black and papery, with fish scales, &c., ...	0	7
Coal, bright and good, but with iron pyrites disseminated, ...	0	4
Shales, blackish, with thin laminæ of bright jetty coal, ...	1	5
Coal, fair strong coal, laminæ in structure (pyrites,)	3	0
Clay, grey flaky clay, ...		

Here it will be seen that there is more than 3 feet of fair coal, which is however, though not largely, impregnated with iron pyrites.

The analysis of this coal yielded to Dr. Macnamara the following results :—

Specific gravity, ...	1·37	Per-centage of water, 16.
Volatile matter, ...	49· 7	Inclusive of water.
Carbon, ...	50· 3	
Ashes, ...	8· 5	

With the exception of the iron pyrites, this is a good fuel. It comes out in good lumps and is sufficiently hard. The greater portion also of the coaly shale given in this section might be usefully economized for any local purposes, if ever this field should be wrought, but is too poor to repay the cost of transport to any distance.

These beds are favorably placed for working, the amount of the dip or inclination is not more than 18° to N. 20' E., and they are very accessible so far as their position with regard to the stream and the surface is concerned, but I am satisfied that the great distance of the place from any port, the very bad state of the small stream down which the coal would have to be conveyed, and the consequently heavy expense of carriage, will preclude these Tsing-koon coals from being worked, so long as other and more easily accessible localities can be found.

The village of Tsing-koon, or rather the site of the old village now marked by a few scattered palm and a ruined pagoda, near to which are some large clearings, is about 6 miles further down the stream than the coal. Just behind or North of the point where the coal is seen in the stream, there was another village similarly marked, some detached fruit

trees and clearings in the jungle, and which was called Noung-bwa ; and passing through the jungle in other directions abundant evidences are met with of how closely populated this District must once have been. At present not a human habitation is to be met with more than a couple of days' journey from Tenasserim Town in this direction.

About 5 miles in a right line below Tsing-koon* the river or stream which, above this, is only passable for rafts even in the rains, becomes deeper, and from that downwards small boats can proceed during the monsoon, and from the junction of the Tsing-koon and Nga woon streams, which together form the Little Tenasserim, larger boats can be navigated.

The position of this coal was at first supposed to be within the territories of the King of Siam. This was however shown to be an erroneous impression by Major McLeod, who visited the place ; and I marched across to the boundary myself and found the water-shed of the central range of mountains, which is universally acknowledged as the boundary, to be about 12 miles almost due East from the coal. There is a path across here into Siam, and I met several people going and returning. The pass along which it winds does not attain any great elevation (not more than 650 feet above the sea,) but the hills on either side rise considerably higher (2,000 with points 3,000.)

Lenya River.—Returning from the Tsing-koon, I visited the Lenya to see the coal fields reported to occur there. Proceeding by water from Mergui along the coast Southwards, we entered the five estuary of the River Lenya, and passing up to the village of that name, exchanged our larger boats for small canoes as before and started up the river, the general course of which here is nearly North and South. After five long and heavy days' work, frequently having to lighten our canoes and pull them up the rapids, in one place having to cut a regular channel through the sand in consequence of the stream being totally blocked up by fallen timber, we reached the locality where the coal had been found. After passing A-tong-wa, about 8 miles above Lenya village, not a single human habitation was to be met with; a few small canoes and a few scattered watch-fires along the bank marked the resting place of the hunter or the rattan-gatherer.

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* On leaving the river here, we marched for some miles along an old and regularly formed road, cut along the slopes of the hill-sides, and which is traditionally known as Alamprar's royal road. It is said to have been constructed by his order for the passage of his army when contemplating the conquest of Siam.

The coal is here exposed in the bank of a small tributary stream, which comes in from the South, and which is called by the natives the Phlia-o or fish stream (Siamese name.) It occurs in an irregularly developed bed, varying from 1 foot to 2 feet and even 2 feet 6 inches in thickness. It is throughout of laminar structure, with their seam of fine jetty coal between the layers and very numerous nodular lumps and masses of a resinous ambery-looking mineral imbedded; the mass of the coal on the fresh fracture iron a very dull lustre and hard pitchy and earthy aspect. The whole group of rocks here has even a more modern look than the beds with coal in the Tenasserim District. The rocks are softer and less indurated, and are more irregular, and more like recent clays and sands.

In ascending order the little section of the coal here exposed is as follows:—

	Ft.	*In.*
Blueish-white, grey, and blackish fine sandy mud, with small black patches or stains, evidently the indistinct remains of plants, (seen,)	3	0
This passes insensibly into a dark brownish bed of the same kind, with small angular grains of quartz imbedded, and this by insensible gradations becomes of a blacker colour from their streaks of coaly matter and small fragments of carbonized vegetable remains. This does not form any definite bed, but is only the upper part of the previous beds, with these slight alterations in texture and composition,	2	8
Coal resting on the irregular surface of this muddy bed, ...	1	6
Mud, clunchy and full of disseminated vegetable remains in rather fragments of carbonized vegetable matter, forming black layers and patches, varying from an almost imperceptible thickness to ½ an inch,	4	0
In this bed are imbedded irregular patches of brilliant jet coal, with a bright lustre, and having a semi-columnous texture. One mun of this extracted yielded a basket of fine brilliant blazing coal; on the outer portion of this the woody structure was quite visible.		
Coal, fine bright pitchy coal; in their seams varying from ⅛ of an inch to 1 inch, imbedded in ferruginous mud, ...	0	10
Mud, fine silty greyish white, with stems and leaves disseminated through it in every direction, both across and along the layers, but slightly carbonized, ...	4	6
Black ferruginous bed, with small nodular masses of the same resinous ambery-looking mineral noticed above and very thin seams of coal,	0	6

Over all these comes a layer of gravel, composed of pebbles of quartzose hard sand-stone and pure white quartz. In this a few small fragments of tin-stone occurs. This gravel is here from 6 inches to 2 feet

6 inches in thickness, and is covered by the stiff-red pseudo-latenti clay, so commonly exposed over the country.

The beds of coal and associated rocks dip at 35° to 38° to E. 15° to 30° N.

Such is the section in immediate connexion with the coal. Below these beds the series of rocks consists of (similarly ascending) of whitish earthy fine sand-stone and indurated mud, slightly calcareous, occasionally and locally so much so as to form a muddy lime-stone. To these succeed beds of partially angular conglomerates, with beds of clunchy clay and muddy sand-stones, dipping as before to E. 30° N. This series is about 300 feet thick. By "partially angular" I mean conglomerates in which the angular character of the broken pebbles imbedded is still retained, although the sharp edges are slightly worn off. Over these comes the coal group as given above, and above this again we have a series of sand-stone beds, soft and muddy, of thick clunchy clays and marks occasionally pebbly, and with a few seams of unevenly deposited carbonaceous matter of an inch to 2 inches in thickness, and fine pebbly conglomerates. The whole gives a thickness of about 600 feet, and has been subjected to several faultings and other disturbances by which the dip and arrangements have been much affected.

From this it will be seen that there is not altogether more than 18 inches of coal, and this can scarcely be called coal, for it is a hard black slaty shale, somewhat stone coal-like in aspect. It is however very interesting from the abundant dissemination through it in irregular little nodular lumps of the resinous ambery-like mineral I have noticed above. This varies in colour from that of a blueish bottle-green to a rich yellowish tint-like fine amber. In fracture it is quite conchoidal and glassy, burns freely, and from its abundance adds greatly to the glazing qualities of the mass.

Its composition is as follows:—

The coal ignites with some difficulty, but then burns with a good flame and strong heat, the lumps become red hot, but do not disintegrate, retaining all their original form. The ashes are white and abundant. The coal comes out of the bed in large and solid masses, and if it occurred in any abundance would prove an useful fuel for many purposes.

Above this main bed, as I have mentioned, and separated by about 200 feet of sand-stones and clays, there is another thin seam of coaly matter; but it is very irregular and in no place more than a few inches in thickness, so that it will be perfectly useless as a source of fuel.

These are all the localities within the Tenasserim Provinces, where coal has hitherto been found. For the reasons I have already given, any detailed search over the District, with a view to tracing out, by a detailed and systematic examination, the extension of these beds, or to discover any new localities, is at present out of the question. The Nga-woon stream, and the lower waters of the Lenya, are two of the Districts in which new beds might be sought for with some probability of their occurrence, and it might be well to direct the attention of the many native hunters who frequent those forests to the fact and induce them to pay some attention to the discovery and reporting of any seams which may be traceable.

I have above simply described the mode of occurrence of these coals, but I would add a few words as to their relative value, position, quality, &c., and first, as to the facilities for carriage of the coal if worked.

The Tenasserim River is subject to the influence of the tides, which, at the ports of Mergui, rise and fall 18 feet for about 45 miles of its course. At the town of Tenasserim, which is 40 miles from Mergui, there is a rise and fall of 8 feet, but the influence of the tides is not sufficiently great to be of much service in the navigation of the river much beyond this. The distance from Mergui to Tenasserim, or back, can generally be made easily in two tides. For several miles above Mergui the banks of the river are low and covered with mangrove swamps. The delta extends for nearly 20 miles North and South and is intersected by numerous channels, the main stream discharging itself close to Mergui town. In this portion of its course, it is a fine broad open river, with abundance of water for boats of all sizes and for all purposes of inland navigation, and this at all seasons of the year.

Above Tenasserim town, the course of the river, which from Mergui is S. of East, suddenly changes to nearly North and South, and for the greater portion of its course, hold this direction in the main. The Little Tenasserim River joins the larger stream from the South at the town of Tenasserim, and above this the depth and quantity of water materially diminishes. As far however as the village of Banlan, 7 miles from Tenasserim, there is no impediment to the free navigation of the river by small boats; above this many sand banks occur, and in several places gravelly ridges cross the channel, which cause small rapids, but in no case is the fall of any extent, or the increase in the rapidity of the current serious. The beds of these shoals are in all cases loose sand or

gravel, and can easily be moved. At the time of my visit (February) the waters were low, though not at their lowest, but the smallest depth of water I found over any of those shoals was 1 foot 10 inches. In the intervening levels, there were, with few exceptions, more than 3 feet. After February, and up to the end of the dry season, the river may probably fall about 1 foot more, so as to reduce the minimum depth to a little less than 1 foot; but this minimum depth only occurs during one month of the entire year, as the rainy season commences much earlier in these Provinces than in Bengal.

The rise of water in the river during the monsoon is often very great. The highest mark of the water line which I could trace at Heinlap was 31 feet above the then level of the water surface, but this great rise can only be occasional and of short duration, the line, marking the more continuous level of the summer stream being only 22 feet above the same point. There is therefore at all times sufficient water in the Tenasserim River to float down bamboo rafts, and for nine or ten months of the year sufficient for barges or lighters properly constructed. This river is not subject to those sudden and destructive floods, which in other streams often cause so much devastation.

All the coal which was formerly extracted from the pits at Thatay-hkhyoung was sent to Mergui on bamboo rafts—of bamboos the supply in the neighbourhood is practically inexhaustible for many years—and this was certainly as economical a plan as could have been adopted; but it is open to the serious objection that the coal thus despatched is generally partly immersed in the water, and so becomes thoroughly wetted. For many hours it was thus exposed to the action of sea-water, and the dangerous effects of such exposure to salt water, with coals containing iron pyrites, as these do, is generally admitted.

The time occupied by the rafts, in going to Mergui from the mine, was generally four to five days. After discharging the coal these rafts were broken up and the bamboos sold, the amount realized from their sale being credited against their original cost. I am satisfied, however, that this plan, although undoubtedly economical, must be abandoned, if these coals be largely worked, probably for the whole distance, but certainly for the lower and tidal portion of the transit.

The three localities I have described, where coal is found on the Great Tenasserim, are so near to each other, that practically the expense and time of transit may be considered as the same for all. During former

operations this transport of the coal was carried on by contract at the rate of 2 annas 9 pie per maund, including the carriage by coolies from the pits' mouth to the river, or for a little less than Rupees 5 per ton. More than one-half of this cost was for the land carriage from the pit to the water's edge, and this would have been to a great extent saved by the construction of the tram-road as contemplated.

The distance from the river bank does not materially differ in any of the three localities. The out-crop at Heinlap, measured along the path through the jungle, which is nearly straight, is 1,291 yards from the river; that at Kanmapying, 1,050. For the whole distance at Thatay-hkhyoung, as I have already mentioned, a level road has been formed and prepared for laying down a tram-way. The country in each of the other localities is well adapted for such a construction, and the cost would be small. There is abundance of timber in the immediate vicinity well suited for all the purposes it may be required for. With reference to the quantity of coal which may exist, I am disposed, after the best examination which the nature of the country would permit, to think that the coals seen at Thatay-hkhyoung and at Heinlap are the out-crops of one and the same bed, which varies in character and in thickness. I am led to this opinion by the general similarity of the section seen at these places. Thus, at Thatay-hkhyoung, although only 6 feet of coal was worked or workable, the seams of jetty coal continued to a total thickness of nearly 18 feet, while at Heinlap the whole of this thickness was of good coal. There is a marked similarity in the beds of shale holding fish remains, forming the roof of the coal in both places, and the general accordance of the group of associated rocks confirms the idea. The coal seen at Kanmapying may come in above the Heinlap coal, and if so, be separated from it by about 160 feet of sand-stones, clays, and shales, or it may be only the prolongation of the same bed, slightly faulted. To prove this definitely, expensive and tedious borings would be required, and these I did not consider justified under the circumstances, inasmuch as the result would not affect materially any workings to be commenced in the District, while the progress of the workings themselves would decide the point.

Assuming therefore that we have exhibited in these out-crops one and the same bed, and that this bed varies in thickness between the two extremes of 18 feet and 6 feet, we may fairly estimate its average thickness as 12 feet or 4 yards; and looking at the specific gravity of the coal,

we may equally assume 1 cubic yard as equal to 1 ton weight. Such a coal then would yield per statute acres 19,360 tons, while the area over which the bed may justly be presumed to extend is not less, and probably much more, than 3 square miles, or 1,920 statute acres. But the angle of inclination at Heinlap being, as I have stated, so high (38°,) it becomes necessary to estimate the amount of coal which may be accessible with ordinary means, rather than the quantity which actually may exist.

A shaft sunk at 50 yards distance from the out-crop to the dip of the coal would reach the bed at little more than 40 yards or 120 feet from the surface, and would command a depth measured along the bed itself of about 65 yards. Now such a shaft, judiciously put down, would enable at least 250 yards on either side of it to be won. This would therefore give $65 \times (250 \times 250) \times 4 = 1{,}30{,}000$ cubic yards or tons of coal. Estimating the amount left in the workings for supports, &c., for waste and loss, as one-third of this, there would still remain nearly 87,000 tons to be obtained. Another shaft, or pair of shafts, sunk at an equal distance on the dip of the bed, would again command as much more; these new shafts being double the depth, or nearly 250 feet, that is, that from shafts of 250 feet in depth, there ought to be procurable 174,000 tons of coal.

For such workings, steam engines and all other appropriate machinery, pumps, &c., would be requisite. I think water power might be, to a considerable extent, available for drawing the coals at least for a considerable time, reserving the steam power for unwatering the mine.

The extent of surface, or horizontal distance along the out-crop, from which the coal could be wrought, is fully 1½ mile, so that there does not appear to be any reason for anticipating a deficiency of supply, or any want of coal within a reasonable distance from the surface; and looking to the future workings of this field, it should be remembered that an examination of the adjoining country shows that the beds with which this coal is associated; and therefore we presume the coal itself have a much lower dip towards the East than along their Western out-crop.

The costs at which the coal could be raised remains to be considered.

At first, and before the workings had reached to any depth, the facilities for the extraction of the coal would be great, and it ought easily to be hewn and raised for one Rupee and a half per ton, or Rupees 2. After

that the expense would considerably increase, but even then I am satisfied Rupees 3½ or Rupees 4 per ton would cover the expense of hewing and winning. To this add 25 per cent. for expenditure in general work, and the cost of the coal at the pits' mouth would be about Rupees 5 per ton. The cost of transit to Mergui, (taking this at the high rate originally paid, namely, 2 annas 9 pie per maund, or Rupees 4-13 per ton,) added to this, would make the total cost of the coal delivered at Mergui Rupees 9-13 or Rupees 10 per ton, or less than 6 annas per maund.*

In the old workings at Thatay-hkhyoung convict labour was largely employed, but I have not above contemplated any continuation of such an arrangement, which would not, I feel confident, be found desirable under any circumstances. A considerable outlay would be requisite, but the return would be immediate, and the extension of the machinery gradual. Indeed a considerable amount of coal might be obtained without any but the most ordinary machinery.†

On the whole I think this small coal field offers a promising and encouraging prospect of coal, of fair average quality, procurable at a reasonable cost and in sufficient quantity to be commercially valuable.

It does not appear necessary to enter into any details as to the proper mode of working this coal, or into any question as to the agency by which the works, if undertaken, should be carried on. Such discussions would be out of my province or premature.

The coals on the Little Tenasserim, or rather on the Tsing-koon River, do not, as I have already stated, appear to me to occur in sufficient quantity to justify any great outlay at present in working it. The distance from the port is great, the stream itself is very shallow and small, full of impediments, and for nearly five months in the year almost useless for any purposes of navigation; and to be rendered available at all would require a very large primary outlay, and a considerable annual expenditure. I shall therefore not enter into any further details regarding it.

* The present (1855) price of coal at Moulmein is more than double this, and a few months back, was more than four times this sum.

† If we suppose primary outlay of Rupees 50,000 (which ought to be much more than sufficient to place this coal field in good working order,) and take the interest on this sum at 15 per cent. this would give an annual charge of Rupees 7,500. If 150 tons of coal were raised per week, and 50 weeks be taken as the working year, this would add exactly one Rupee to the cost of each ton.

Similar remarks will apply to the coal on the upper waters of the Lenya. It is to be regretted that this coal did not prove of better quality and more abundant. The entrance to this river is more easily made from sea than the port of Mergui, and the river is itself a fine open stream. Its geographical position also further to the South makes it a more favorable situation for the supply of the Straits, &c., than Mergui, but there appears to me no reason to hope for any large deposits of good coal in this vicinity.

All the other localities have been already noticed.

But the greatest mineral wealth of the Southern portion of the Tenasserim Provinces consists in the extensive and valuable deposits of tin ore which they contain. In the granite of the central dividing range, which separates these Provinces from Siam, and more especially (so far as my opportunities for examination extended) towards the outer edge of this granite or rear to its junction with the highly metamorphosed slates with which it comes into contact, tin-stone is an essential ingredient in the mass of the rock, occurring disseminated through the granite in small crystals, similarly arranged to the quartz and felspar of the rock ; and in some cases, as at Kahan hill, near Mergui, veins of granite cut through and traverse the more recent rocks and contain large and abundant crystals of tin-stone.

The principal source of the ore is however in the extensive deposits of "stream tin," where the degradation of the previously existing source has produced a detritic gravel, broken up and washed down the slopes of the higher ground and accumulated in all the flats and stream-courses. So abundant and so widely disseminated are these deposits, that it may safely be said, that from the parallel of the town of Ye Southward to the boundary of the British territories on the Pakchan River, or extending through more than 4° of latitude, the places where, from the physical conformation of the ground, such deposits would be looked for, and where they do not occur, are the exceptions to the general rule.

My time did not admit of my attempting to trace out the boundaries of these deposits or even of visiting many which I should like to have seen, but the general conditions of their occurrence are the same all over the District. Of course there is great variation in the relative abundance in which the ore is found, and in the comparative size of the fragments in

which it occurs (the latter regularly diminishing with the distance from the source of the ore to which the fragments have been transported); but there are few of these places in which the working for such ores would not prove profitable.

These deposits have in former times been largely worked, principally, if not entirely, during the period of the occupation of the country by the Shans. In very few cases, even now, do the Burmese wash for tin. In almost every case this is done by Shans, who work either individually, or in company of several who unite to work a certain locality. Where there is this combination of interests, in most cases the work is found to be carried on under the general management of some Chinese settler, who purchases all the tin-stone procured at fixed rates, and furnishes the labourers in return with such supplies as they may require. The few who work separately bring their ore to Mergui, or other towns where it is purchased, principally by Chinamen, and by these is smelted. The metal from these Provinces, with very trifling exceptions, is all exported to Penang, and from thence to Great Britain and other places.

The only extensive workings, carried on under one head, and on any general system in this country, are just beyond the boundary of the British Territory and within the Kingdom of Siam. The Southern limit of British Territory is defined by the Pakchan River, and close to its mouth, on its Southern bank, is the Rhenoung Creek. After a narrow passage through a channel bounded on either side by rocky ground, upon which a settlement of Malays has been located, who act as a kind of frontier police for the District, the creek expands into a wide and open bay, divided by numerous islands covered with mangroves. Turning to the North the small creek leading from this bay to the village soon becomes very trifling in extent, and although passable for small canoes at high water up to the village, is quite dry when the tide falls. The village of Rhenoung itself is beautifully situated close to a range of high and very picturesque hills, and here is the residence of the Governor of the Rhenoung Province or District. He is a Chinaman of great intelligence and ability, and now somewhat advanced in years. The entire Province, as I understood, is held by him under the King of Siam for a fixed revenue, and by far the largest portion of this income is derived from his tin-washings. There was much evidence of great comfort and ease about the whole establishment.

The tin-washings at Rhenoung are situated about 5 miles from the village to the East of the outlying ridge. A mountain stream passes through this ridge in a deep and narrow gorge in the granite, the general direction of the course being East and West, and flows past the village.

At the mines or workings, I found a large establishment of Chinese in full work, busily engaged in making preparations for the coming season of the rains, during which, from the abundant supply of water, the principal operations are carried on. A large and substantially constructed office and store, kitchen, a refectory and work-shops, and sleeping sheds are compactly arranged on one side of the flat in which the washings are carried on. Water-courses intersect the whole of this flat, and the unceasing hum of a water-wheel, with a series of chain pumps, impressed the idea of systematic and well-devised plan of operations, which formed a very marked contrast to the careless and irregular way in which, generally speaking, the ore is sought for in these Provinces. Such a busy scene was scarcely to be looked for in the midst of an unbroken jungle.

The workmen engaged are all regular labourers, who have no other occupation. They go to work and leave off at fixed hours, at the striking of a gong (or wooden drum,) and they are supplied with every thing; their food being all regularly prepared for them at stated times. During my visit I had an opportunity of seeing them at dinner. The supply of food was most abundant, the quality excellent, and the articles of food very varied, and I was asked in the most friendly manner to partake of their well-cooked meal. The entire arrangement evidenced a regular, continuous and systematic employment of labour. About 200 men were thus engaged.

The system of washing here adopted consists in simply throwing the gravel and sand in which the tin-stone is disseminated into a long continuous trough, the bottom of which has a gentle inclination, and keeping the gravel slightly agitated by taking it up gently, while a stream of water passes over it. The lighter and stony portions are of course carried down by the water, and the heavy ores falling to the bottom are subsequently removed and stored. By this system, as here conducted, some of the finest particles of the ore are carried off and lost; but the per-centage is very small, owing to the length of the trough employed, and its gradual increase in size and consequent diminution of the force of the stream near its lower end.

The ore thus obtained is all sent in to the village on elephants kept for this purpose, and is there smelted. In the manufacture of charcoal for the reduction of the ore, there is also evidence of the skill of the proprietor. Instead of the open pits in which charcoal is ordinarily made in India, and in the adjoining Districts, here there are regularly constructed kilns for the purpose; and contrasting the two methods of manufacture and their results, I am satisfied that the charcoal thus obtained is 20 per cent. superior to that ordinarily produced in these countries.

At the residence of the old Governor in the village, and within the large palisade, which surrounds his establishment, is a large smelting-house of the ordinary Burmese construction, in which are three furnaces. These are supplied by bellows of the kind common in the Provinces, consisting of a long straight cylinder, or hollowed bulk of wood, supplied with valves at either end, and in which a piston is simply drawn backwards and pushed forwards alternately by manual labour. At the period of my visit, no smelting was being carried on, but the processes here adopted do not differ from those in ordinary use everywhere within the District.

The entire proceeds of these workings, which must be very considerable, although I could not ascertain the exact amount, are despatched to Penang, in boats belonging to the Governor, one of which is commanded by his son, and there sold; all the needful supplies being brought back in return.

I have described these workings in some detail, both because they are, I am sorry to say, the only place I saw where any systematic plan of operations was adopted, or where the smallest improvement, on the most primitive and rude methods, had been introduced. They are also by much the most extensive workings in this portion of the country, although of course trifling as compared with many of those in the Island of Banka and other places in the Straits of Malacca.

Within the British Territory I did not see or hear of any place where the tin-stone is not separated by the primitive mode of washing in a shallow wooden bowl, or dish, by the hand. With this process I satisfied myself by several trials, that when the ore occurred in tolerably large crystals or fragments, the smaller particles were frequently washed away and disregarded, to the loss in some cases of nearly 50 per cent. of the entire quantity; while in other localities, where the ore was in a very

fine and minute state of division, the time and labour involved by the necessary slowness of the process rendered it unremunerative.

Among many other localities where tin-stone is thus obtained within the British territory, may be mentioned

Malee-woon, on a branch of the Pakchan River. There a considerable quantity of tin-stone is procured from a coarse gravelly detritus, chiefly composed of granite pebbles. It is washed over a District of some miles in extent, and is all sold to Chinese settlers in the village of Malee-woon, who smelt and export it. In this District tin, cast into little ingots, in the shape of a frustum of a cone, forms the ordinary currency of the place: they are generally cast into two sizes, which pass respectively for 4 annas and 2 annas; but there is no great accuracy attempted or required.

The washed ore is sold at Malee-woon by measurement. A bamboo, 12 inches long and $3\frac{1}{2}$ inches diameter, is used as the measure, and its contents sell for Rupees 2. In this amount of ore, thirteen of the small 4-anna ingots are said to be contained. The great mass of the ore is made up for exportation in much larger ingots, which weigh on an average 27 lbs., and for the production of one of these, the contents of six bamboos, or Rupees 12 worth of ore, are stated to be requisite. The price of these ingots varies of course with the market price of tin. During four days and four nights' continuous smelting, they state that 50 ingots of this large size are reduced, and that the first charge is sufficiently reduced in one hour and a half to be run off. For this amount 40 baskets, or 40 piculs, of charcoal and 280 bamboos of ore are required.

From the village of Malee-woon alone, from 1,500 to 1,600 ingots of this kind are said to be turned out in each year. The smelting is not carried on at the season during which I was able to visit these localities, so that I could not practically test the statements made to me, but as I found on comparison that the amounts mentioned by one man agreed with those stated by others, without any possibility of collusion, I am induced to think that the quantities given above are tolerably correct. On the average, by their very rude processes, they do not obtain from this ore at Malee-woon more than 30 per cent. of metal.

At *Pakchan* village, and at one or two other places, in the same District, tin-stone is also procured.

Bokpyen is another centre, from the neighbourhood of which a very considerable amount of tin is annually sent; there also it is principally

purchased in the state of tin-stone, smelted and exported by Chinese settlers.

In many places about *Sadying*, in others along the Lenya River, (as at Mounrung,) and up many of the creeks which fall into this river, and also at the head-waters of the main stream, tin-stone is found. At Mounrung it occurs very abundantly in large-sized fragments and of rich quality, and here there is evidence of the extent to which it was formerly wrought, although now the place is abounded. Numerous deep cuts and water-courses still remain, and some of good size, although a very small portion of the available field has been trenched upon.

In the valley of the Tenasserim River, and in many of its tributaries, as was pointed out by Colonel Tremenheere in 1844, tin-stone is abundant. It is found along the upper waters of the Nga-woon and of the Tsing-koon, the two main branches which unite to form the Little Tenasserim up many of the minor tributaries of the same river, as the Thabawlick, the Tagit, the Engdan, &c. &c., up the Great Tenasserim in many localities; and towards its head-waters in the parallel of Tavoy, it is said to be abundant. Frequently in the midst of what is now an unbroken jungle, deep pits are met with—old workings, from which tin-stone was formerly procured, but which are now half fallen in.

Close to the town of Mergui, tin-stone is found, but in small quantity, and with it minute scales of gold. At Kahan Hill, about 3 miles from the town, it occurs abundantly in a coarsely crystalline granitic vein, which traverses sand-stone.

Passing Northward from Mergui, tin-stone is met with, although not abundantly along the Western slope of the minor ridge, which divides the valley of the Tenasserim from the sea, and passing Northwards from Tavoy into the District of Henzai, tin-stone again becomes abundant in connection with the outer run of granitic hills, which forms the long promontory, separating the Tavoy River from the sea, and passes Northwards from thence into the Ye District. Here also, as in many other places, gold in minute scales and grains is found with the tin-stone.

In some of these localities, a single family may still be at work, uniting the washing for tin-stone with other pursuits; in others, a few men unite, and during the rainy season, when a supply of water is easily obtained, continue their washings. Of other localities, the knowledge only traditionally exists among the people, and during my rambles the guides who accompanied me, have often been much more surprised

than I was myself, at coming suddenly on old excavations, long since overgrown with jungle.

Among these native workmen no place is considered worth much trouble in working, in which two men, one digging and one washing, cannot readily obtain a viss weight of the washed ore in one day,* although many places not so rich in ore as this are actually worked as occasion may offer. Some localities are traditionally stated to be so rich, that six viss of ore can be procured daily by two men, (as in some of the tributaries of the Lenya,) but the great distance and difficulty of access to such places, and the constant necessity where no proper organization exists, of continually returning for supplies, prevent these being visited, excepting rarely and at distant intervals.

So far with regard to the extent of area over which the tin-stone is met with, as to the quantity of the ore, a few words will suffice. I have mentioned the average return which a native workman (a Shan) looks for from his rude mode of washing.

To obtain this quantity of washed ore, the quantity of gravel and sand raised varies very materially in different places, and also depends, in some degree, on the skill of the workman. No average can therefore be fairly given, but it is much more important to know the thickness of the deposits generally.

The section at Rhenoung is thus :†—

	Ft.	In.
Clay surface soil and stiff clay, from ..... 2 inches to	2	0
Gravel, chiefly quartz pebbles, much rounded, average size about 2 inches diameter, pebbles of granite, hard siliceous slate, &c., but little sand, no tin-stone, ...	3	6
Gravel, upper layers fine, passing down into a gravel of about the same coarseness as that above, and very similar in composition, tin-stone abundant, more especially towards centre of deposit, ...	6	6
Clayey gravel below, not proved. The gravel occasionally rests directly on a hard siliceous slaty rock, ...		
At Malee-woon, the section exposed gave clay, stiff reddish-colored,	4	6
Gravel, chiefly quartzose, occasionally very coarse, with large lumps of quartz and granite, with tin-stone, ...	5	0

The bottom portion of this, which extends more than 2 feet 6 inches below this depth, is not rich in tin-stone.

* A viss is 3 lbs. 10 oz., about 100 viss being exactly 365 lbs.

† I give this section, although it is not within British Territory, as an illustration of the general character of the deposits.

In the upper part of the Lenya River, the tin-stone bed of gravel is 4 feet thick, under 2 feet to 2 feet 6 inches of sandy clay. At Mourung, under a coating of a few inches to 2 feet of clay and sand, with large blocks of quartz, we reach the tin-stone bed or layer, and which is at least 5 feet thick. In the Tenasserim District the tin-stone layer varies from 4 feet 6 inches to 7 feet in thickness. In the Henzai basin the tin-stone is in places covered with a thick deposit of gravelly clay, sometimes 5 to 10 feet thick, while in other places its surface comes up to the thin covering of soil. In the small stream which passes the village of Om-bin-kuin, the bed of the channel, and its banks, with the exception of the clayey soil above, all yield tin-stone.

These facts are abundant to show, that over a very extended area there is a very large amount of this valuable ore spread, and that in almost every instance, it is readily accessible, being nowhere covered up by any considerable amount of more recent deposits.

A want of a continuous supply of water is in several of the localities I have mentioned a difficulty to be met, before these deposits of tin-stone can be profitably economized, but in most cases a very limited amount of expenditure would suffice to obviate this difficulty. At present nothing whatever is done in this matter. The ordinary streams during the rainy season supply the desultory labour of the untrained workman, and a few months' labour produces him a sufficiency for his support, while the rest of the year is at his disposal for hunting and other pursuits.

With reference to the quality of this ore of tin in the Tenasserim Provinces, this necessarily varies over so large an area, and probably it will be sufficient to state that they are as a whole fully equal to the similar ores obtained in Cornwall. From the poorest of these by the rudest processes, and without any of the most ordinary mechanical appliances which modern skill could introduce, from 30 to 40 per cent. of metal is obtained by the native workmen—from others, so high a per-centage as 60 per cent.

With the tin-stone in a few localities, Wolfram, as I have already pointed out in former papers, is to a small extent intermixed, but in the majority of the places I have mentioned, no injurious ingredient which cannot be readily got rid of occurs.

Why such valuable deposits of an ore, which requires in its reduction no expensive furnaces, no large constructions, and no great manipulative skill, should have hitherto been so entirely neglected by Europeans, I am

at a loss to conceive. Possibly the extent of these beds has not been known, although their occurrence in many places was made public by Colonel Tremenheere many years since; still no attempts whatever have been made for their more extended or more systematic working. A grant of some 10,000 acres has been, I believe, made by the Government to two persons for "mining purposes," and having heard much of the richness of the Henzai District, where this grant is situated, and of the great works in operation there, I visited it with anticipation of seeing much, but was greatly disappointed to find that literally nothing was being done, or had been done, in the direction of mining. The good timber of the District, and the rich supplies of wood-oil, were being largely worked up, but the "mining purposes" for which the grant was made were represented by a single individual and his daughter washing at intervals for a little tin-stone which they sold to the proprietor.

In no other case that I am aware of has a grant for "mining purposes" of waste lands been made, nor until the system on which such grants are now made be modified is it desirable that such should be made.

I have not entered into any calculations to show the cost of obtaining this ore, of smelting, of export, &c., or of the profit to be derived therefrom. Such calculations could, in my case, be only based on isolated facts and experiences, and I am confident, that they would never be so satisfactory as the simple consideration of the fact, that this ore is largely worked now, in the most desultory, and more unskilled manner possible, but that in all cases a *large profit* is derived from the occupation.

A most serious drawback to the opening up of this country exists in *the total absence of any roads.* Throughout the entire range of the Tenasserim Provinces, with the exception of the few roads immediately around the stations of Moulmein, Tavoy, and Mergui, not a single road has been made within the quarter of a century during which these Districts have been under British Rule. The few short roads which do exist are of Burmese construction, and when leading to a monastery or pagoda are frequently of excellent and permanent workmanship; but there are always short, proceed in every possible direction, and are in no way intended for, or designed to aid the traffic of the country. It is true that over a large portion of the Provinces the ordinary means of communication is by water, and that stretching, as the country does, in a narrow strip along the sea-board, the sea itself forms the great highway from North to South; but such a communication can scarcely be said to

be open during the monsoon, or for nearly one-half of the year, during which time few native boats will venture out; while the internal communication is closed for a great portion of the year by the drying up of the creeks during the rainless months. Thus, during the season in which there is easy means of communication from without, there is none from within, and no continuous traffic of any kind could exist.

I pointed out the necessity of such roads being opened out, in reporting on some specimens from these Provinces in the year 1851, and a personal examination of the Districts referred to then has only more strongly impressed upon me the urgent want of them. In fact I do not see how any marked improvement in these Provinces can possibly be looked for, until some facilities of inter-communication be afforded to the inhabitants of the several Districts.

Another very serious difficulty in undertaking any mining works, or even in the making of roads, is the great want of labour, owing to the very scanty and sparse population of the Provinces. For "mining purposes" alone, I do not look upon this as a very important matter. An abundance of Chinese can be obtained for all such works at fair remunerative wages from the Straits and Singapore, and they prove as skilled and excellent workmen as any in the world. Indeed, it would require long continued instruction to make a Burman a good miner, while by employing the Chinese in such works the others would be left to their natural agricultural pursuits, to the cultivation of the country, and to thus providing supplies of the ordinary kind; but for labour of an ordinary kind there is undoubtedly a great deficiency of supply.

I believe, from every enquiry I was able to make, that there would be no difficulty whatever in procuring from India, either from Bengal or Madras, thousands of labourers, who would be delighted to go to these Provinces, induced by the certainty of an enhanced rate of wages; and such is the present pressing want of labour, and the consequently very high pay given, together with an increasing demand, that any numbers, which could be imported for several years to come, would have but a slight effect in lowering these wages.

Several hundred natives of India now come voluntarily every year, chiefly from Madras, but there are no sufficient regulations regarding their transit. They come crowded into native vessels, often barely seaworthy, often too in a very much larger number than there is room for, without proper supplies of food or water. They suffer much during the

passage, and are constantly cheated by the masters of the vessels in which they sail. For a passage across from Madras in this way the ordinary rates are from Rupees 10 to 12; and this expense and exposure, several hundreds, as I have said, annually incur voluntarily and willingly; but from Bengal, they can seldom get to Moulmein for nearly double that sum. The charge for a deck passage by the steamers is, I believe, Rupees 22, and excepting in the rapidity of the voyage, and the certainty of a fair supply of water, they are more uncomfortable on board the steamers than in native crafts. No preparation whatever is made for them, they are exposed to all weathers, and are not permitted to make such temporary expedients for their own protection as every native would resort to, but which could not be allowed as interfering with the arrangements of a large and well-disciplined ship. To a native labourer the sum I have mentioned is perfectly prohibitory, and so long as this continues the charge, none such can be expected to take advantage of the facilities which a regular periodical steam communication might be expected to offer.

That the natives are willing, and anxious to do so, in preference to the danger and delay of other modes of travelling, is obvious from the constant flow of deck passengers to and from Rangoon and Moulmein. Their number averages I believe more than a hundred each voyage, and I have on more occasions than one seen many who were most desirous of going refused, as a sufficient number were already on board. The sum demanded for this passage, although high, is still within their reach, and they gladly pay it in preference to running the risks of native conveyance.

The question of the easy and abundant importation of labour is one of the most vital importance to these Provinces. There is not now a population sufficient for the ordinary cultivation of the country, much less for the supply of any increase demand for new works. Tens of thousands of acres, nay of miles of country, which could readily be made most productive, are now lying waste—the abode of the wild beast that roam the forests, for miles together, I have walked through—unbroken jungle and coppice, now growing on lands which once were evidently well inhabited and fully cultivated. In the midst of the forest, you meet ruined temples now covered with rank vegetation. A mangoe tree, or a group of palms, point out the former abode of man, where the intense quiet of the solitude is now only broken by the snort of the tiger, or the

trumpeting of a startled elephant. Where cultivation was once found profitable, no doubt can be entertained that it would be so again. War and tyranny, with all their evil consequences, drove from their homes the former inhabitants, and the noble task of renewing the country is still before any one who will undertake it.

I have not in these remarks attempted to enter into any more minute account of the general geological structure of the country than was absolutely requisite to explain the position, &c., of the coal and other deposits. A careful comparison of the fossils procured will be necessary for this, which I have had no opportunity of accomplishing as yet, and maps will also be required, which involve care and time in their preparation.

(Signed) THOMAS OLDHAM.

No. 1671.

FORT WILLIAM,

PUBLIC WORKS DEPARTMENT,

PUBLIC.

The 14th September 1855.

OFFICE MEMO.

THE undersigned has the honor to return herewith to the Secretary to Government in the Foreign Department the Report from the Superintendent of the Geological Survey of the results of his examination of the coal deposits in the neighbourhood of Thayet-myo, forwarded with Extract from that Department, dated the 25th ultimo, with the view to its being published (together with such portion of the previous* correspondence as he may think advisable) as a "Selection from the Records of Government."

* Construction, 15th June 1855, Nos. 149 and 150.
Construction, 17th August 1855, Nos. 92 to 97.
Docket from Foreign Department, No. —, dated 25th August 1855, with one original Enclosure.

It is requested that the original papers sent herewith may be returned after selection has been made.

(Signed) W. E. BAKER, *Lieut.-Colonel,*
Secy. to the Govt. of India.

No. 2434.

To

C. BEADON, ESQUIRE,
Secy. to the Govt. of India,
Foreign Department.

SIR,

I BEG to report for the consideration and orders of the Hon'ble the President in Council, that the H. C. S. *Sesostris*, on her arrival here from Rangoon on the 14th instant, brought with her two bags of coal, which had been found on the bank of the Irrawaddy, within the British Territories, 9 miles from Thayet-myo, and not more, as I am informed, than 2 miles from the main stream of the river.

2. This coal (2 maunds 23 seers) was sent up by Mr. C. Berry, Chief Superintending Engineer at Rangoon, as a sample of 50 maunds that had been sent on board the H. C. S. *Bentinck* by Lieutenant Ardagh, Deputy Commissioner at Prome, and on trial in the furnaces of that vessel pronounced on favorably.

3. Immediately on its receipt, I requested the Chief Superintending Engineer at Kidderpore to make trial of it, and the result is shown in a letter from Mr. Jones, under date 19th instant. From this it will be seen, that the coal sent from Prome by Lieutenant Ardagh was tried in the furnace of a small engine used at Kidderpore, and that it has proved equal to Burdwan coal and less than 25 per cent. inferior to English. The coal from Pegu was tried against picked Burdwan and very good English coal.

4. The obtaining of a supply of coal from a mine 300 miles up the Irrawaddy, equal in quality to Burdwan, would be of most important advantage, even in a commercial point of view only, as it would enable the Government and other steamers to ply on the various branches of Irrawaddy below the mine at a greatly reduced cost.

5. Under all the circumstances of the case, I would most respectfully urge on the consideration of the Hon'ble the President in Council the expediency of impressing on the Commissioner of Pegu the desirableness of an immediate examination of the seam of coal that has been discovered in such an eligible position on the Irrawaddy, with a view to its being worked and the coal made available for the service of Government and the public at as early a date as possible.

6. Perhaps His Honor may consider the case of sufficient importance to despatch a practical miner with necessary tools and a few workmen from Calcutta.

I have, &c.,

(Signed) T. E. ROGERS,
Supdt. of Marine.

Fort William;
Marine Supt.'s Office,
The 21st April 1855.

No. 30.

To

J. SUTHERLAND, ESQUIRE,
Offg. Secy. to the Supdt. of Marine.

SIR,

IN compliance with the request of the Superintendent of Marine, I have the honor to state that I have tried, in the small steam boiler, driving the punching and drilling machines in the Dock-yard, a sample of coal sent by Mr. Berry, Chief Superintending Engineer of the Rangoon Naval Yard, against two other kinds of coal, and beg to forward herewith a detailed statement of the trial. From the result it would appear that the sample sent from Rangoon is about equal, or perhaps a little superior, to Raneegunge coal, as the difference of time in its favor is 3 minutes and the ashes left is 12 seers less than those from Raneegunge coal.

Enclosed I beg to return the letter which accompanied the coal from Mr. Berry.

I have, &c.,

(Signed) M. JONES,
Chief Supdg. Engr.

Kidderpore Steam Foundry,
The 19th April 1855.

Statement of Trial of Coal sent from Rangoon Naval Yard, by the Chief Superintending Engineer, against Raneegunge and English Coal.

Mr. Berry's Coal.		*Raneegunge Coal.*		*English Coal.*	
	B. M. S.		B. M. S.		B. M. S.
Quantity, ...	2 23	Quantity, ...	2 23	Quantity, ...	2 23
Commenced burning, @	10-20 A. M.	Commenced burning, @	9-53 A. M.	Commenced burning, @	10-20 A. M.
Consumed, ... ,,	1-40 P. M.	Consumed, ... ,,	1-10 P. M.	Consumed, ... ,,	2-45 P. M
	H. M.		H. M.		H. M.
Time of burning,....	3 20	Time of burning,.. ..	3 17	Time of burning,.. ..	4 25
			M. S.		
Ashes and Cinders left,	36 Seers.#	Ashes and Cinders left,	1 8	Ashes scarcely any.	

(Signed) M. JONES,
Chief Supdg. Engr.

No. 1473 OF 1855.

FROM

J. W. DALRYMPLE, ESQUIRE,
Offg. Under-Secy. to the Govt. of India,

To

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated Fort William, the 25th April 1855.

FOREIGN DEPARTMENT.

SIR,

I AM directed by the President in Council to forward to you for report the accompanying copy of a letter and of its enclosure from the Superintendent of Marine, dated 21st instant, No. 2434, regarding the coal that has been discovered on the banks of the Irrawaddy, and found on trial to be of a superior quality.

I have, &c.,

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

MINUTE BY THE HON'BLE J. A. DORIN.

Dated the 26th April 1855.

I HAVE just received from Mr. Piddington, the Curator of the Museum of Economic Geology, a specimen of coal brought up from Pegu, which, he has analyzed, and pronounces equal to the best English steam coal.

It appears that this coal was found at Thayet-myo, within our newly-acquired Provinces, and in an easily accessible site close to the banks of the Irrawaddy.

This discovery is so valuable, that I think it should be followed up without delay, and measures taken to secure the advantages that must result from a supply of coal easily obtainable and suited to all purposes of maritime and railway steam use.

The Commissioner in Pegu should be called on to report on the discovery, the exact position and extent of the coal field; to whom the land belongs; and if, as is probable, to the Government, to take measures to prevent its alienation or misappropriation, pending further instructions from Government.

If this coal turns out to exist in abundance, and of the quality represented by Mr. Piddington, its discovery will be one of the most valuable acquisitions yet made in aid of material progress in India.

(Signed) J. DORIN.

No. 1486 OF 1855.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated Fort William, the 27th April 1855.

FOREIGN DEPARTMENT.

SIR,

IN continuation of my letter No. 1473, dated the 25th instant, I am directed to inform you, that a further Report of the excellent quality of the coal found near Thyet-myo, on the banks of the Irrawaddy, having reached the Government, the Hon'ble the President in Council authorizes you to take immediate measures for providing a sufficient supply for the wants of the Government steamers employed in the Province, and for preventing the alienation or misappropriation of any part of the coal field, pending further orders from the Government.

2. Professor Oldham has been consulted as to the best means of obtaining a thorough survey and examination of this coal field. In the

meanwhile you are requested to report what is already known about it, as to its position, extent, and the persons, if any, who hold or claim any proprietary interest in it, or in the soil under which it lies, and to state what steps you propose to take for carrying out the instructions conveyed in the preceding paragraph.

I have, &c.,

(Signed) CECIL BEADON,

Secy. to the Govt. of India.

No. 1487 OF 1855.

FROM

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India,

To

CAPTAIN T. E. ROGERS, I. N.,

Superintendent of Marine.

Dated Fort William, the 27th April 1855.

FOREIGN DEPARTMENT.

SIR,

WITH reference to your letter No. 2434, dated the 21st instant, reporting the discovery of coal on the banks of the Irrawaddy, near Thayet-myo, I am directed by the Hon'ble the President in Council to forward, for your information, copy of two letters addressed to the Commissioner of Pegu, and to request that you will direct the Officers of the Marine Department in Pegu to co-operate with the local authorities in making the produce of this coal field available, as soon and as largely as possible for the use of the Government steamers in the Province.

I have, &c.,

(Signed) CECIL BEADON,

Secy. to the Govt. of India.

No. 1488.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

T. OLDHAM, ESQUIRE,
&c. &c. &c.

Dated Fort William, the 17th April 1855.

FOREIGN DEPARTMENT.

SIR,

WITH reference to the correspondence noted in the margin, of which a copy is enclosed, I am directed to request that you will state for the information of the Hon'ble the President in Council what steps you think had best be taken for obtaining a thorough survey and examination of the coal field recently discovered on the banks of the Irrawaddy in the Northern part of the Province.

From Superintendent of Marine, dated 21st April, No. 2434.
To Commissioner of Pegu, dated 27th April No. 1486.
To Superintendent of Marine, dated 27th April, No. 1487.

I have the honor to be, &c.,
(Signed) CECIL BEADON,
Secy. to the Govt. of India.

GOVERNMENT No. 52 OF 1855.

No. 10, GENERAL.

FROM

MAJOR A. P. PHAYRE,
Commr. of Pegu and Agent to the Gov. Gen.,

TO

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,
Offg. in the Foreign Department,
Fort William.

Dated Yay-ghen, in Tharrawaddy District,
The 5th May 1855.

SIR,

I HAVE much satisfaction in forwarding, for the information of the Hon'ble the President of the Council of India in Council copies of letters as noted in the margin,

From the Deputy Commissioner of Prome to the Commissioner of Pegu, No. 184, dated 2nd May 1855.

From the Deputy Commissioner, Prome, to Captain White, Assistant Commissioner, Thayet-myo, No. 113, dated 19th March 1855.
From Captain J. S. D. White, Assistant Commissioner, Thayet-myo, to the Deputy Commissioner, Prome, No. 187, dated 29th April 1855, with copy of Enclosure marked A.

relative to the discovery of a seam of coal in a hill about 6 miles from the station of Thayet-myo. The credit of the discovery is due to the exertions of Captain White, the Assistant Commissioner stationed there, and the coal has been very favorably reported on by the Engineer of the H. C. S. *Mahanuddy*, copy of whose Report is annexed.

2. Captain White has obtained the assistance of five experienced miners from Her Majesty's 29th Regiment. These men are now engaged in running a gallery through the hill in which the coal is situated, with the view of striking on the spot where it is believed two seams unite into one.

3. Captain White promises to report hereafter the line by which he proposes to convey the coal by tram-way to the river, so as to be available for steamers. When this is received, I will forward the same for the information of the Hon'ble the President of the Council of India in Council—in the meantime, I beg to solicit sanction to the advance of Rupees 500 on account of the expenses of the mining operations.

4. I would beg to suggest that if Professor Oldham, now I believe employed in the Tenasserim Provinces, can be spared to look at this seam of coal, it will be very desirable that he should do so.

I have the honor to be, &c.,

(Signed) A. P. PHAYRE,
Commr. of Pegu and Agent to the Gov. Gen.

GENERAL No. 184.

To

MAJOR PHAYRE,
Commissioner of Pegu.

Dated Prome, the 2nd May 1855.

SIR,

I HAVE the honor to submit copy of a Report on the coal vein found below Thayet-myo, which I have just received from Captain White; also of a letter of mine to his address, desiring him, on my own responsibility, to incur an expenditure of Rupees 500 in working the mine, in addition to any money which the sale of the coal worked may

fetch. This I purpose adjusting by making the selling rates a little more than what it can be actually dug for, so as to allow of a small profit being realized.

I solicit your sanction to this advance.

I have the honor to be, &c.,

(Signed) R. D. ARDAGH,

Deputy Commissioner.

GENERAL No. 113.

To

CAPTAIN J. S. D. WHITE,

Assistant Commissioner, Thayet-myo.

Dated Prome, the 19th March 1855.

SIR,

HAVING seen a Report of the Engineer of the Steamer *Mahanuddy* on the coal which you had tried by him, and which appears to be excellently adapted for steam purposes, I have the honor, with reference to your last communication on this subject, to authorize you, on my responsibility, laying out in advance a sum not exceeding in gross Rupees 500, in excavating, &c., the sum to be recovered by sales to the river steamers of the coal excavated.

The amount of fuelling required for the trip hence to Prome is about 4,000 billets (in wood) I understand, which costs Rupees 40 or thereabout.

In coal I believe some 2 tons (54 to 56 maunds) will suffice, you will therefore be able not only to wipe off the Rupees 500 now advanced, but also to amass a small fund for working purposes by charging for this coal in gross what is paid for by the river steamers for wood, that is, Rupees 40 for 2 tons, which will give about double the rates of cost of coal at Calcutta, where it sells for Rupees 0-6-0 per maund.

To carry on the operations on a more extensive scale, I shall make due application to the Commissioner on receiving your promised Report.

I would suggest that the temporary service of one or two steady men, who are practically acquainted with coal mines, be procured from the Commander of Her Majesty's 29th Regiment. They will be useful in directing operations.

I have, &c.,

(Signed) R. D. ARDAGH,

Deputy Commissioner.

No. 187, GENERAL.

FROM

CAPTAIN J. S. D. WHITE,
Assistant Commissioner,

TO

CAPTAIN R. D. ARDAGH,
Deputy Commissioner, Prome.

Thayet-myo, the 29th April 1855.

SIR,

IN continuation of my several letters to your address on the subject of coal, I have now much satisfaction in informing you that a seam of that valuable mineral has been discovered, of such a quality, and so favorably situated, that I trust considerable facilities, in the way of fuel, will be afforded to steam navigation on the Irrawaddy.

In December last, being driven away from my researches on this subject in the neighbourhood of Knay-donk in Thayet-myo by the prevalence of fever, I directed the hills South of Thayet-myo to be examined, having every hope, from information received and the bearing of the shale beds, that ultimately coal would there be found. In this hope I have not been disappointed, *vide* accompanying document A. I beg further to add, that the opinion expressed by the Engineer of the H. C. S. *Mahanuddy* has been endorsed by several experienced Officers commanding vessels of the Irrawaddy Flotilla, whose written Reports however have not yet come to hand.

By the kindness of Brigadier Lane, C. B., and Lieut.-Colonel Smith, Her Majesty's 29th Regiment, I have been enabled to avail myself of the assistance of five practical miners, whose opinion of the coal I am happy to say is highly encouraging.

Position and bearing of the coal.

The Htoun-doung coal vein is situated in a low range of hills South of Thayet-myo, and about 2 miles from the river bank at its nearest point. From the spot where the excavation is proceeding, a descent of 500 yards to the valley level has to be overcome, no difficulty of moment may however be apprehended to the formation of a tram-road.

Roads to the coal.

From the North side of the vein an old cart-road runs to within 150 yards of the spot. Not having been in use however for some time, some expenditure will be requisite to put it in order. From the South there is a tolerable cart-road, much frequented by lime-burners, to within 500 yards of the excavation, as

above stated. It is by this route, from my present expetience, I am induced to believe the coal will have to be wharfed on the river bank, but this will depend upon, whether it is deemed advisable to establish a coal depôt at Thayet-myo, or Htoun-doung-yna, or at Pyt-tha-layn-yna, South of the Htoun-doung hills. I will briefly recount the respective advantages of these routes as far as I can at present form an opinion.

First,—The Southern route is some 1½ miles nearer to the river bank than the other, and apparently a tram-road could be constructed at comparatively a trifling cost. From Pyt-tha-layn-yna the coalc ould be shipped on lighters, either for transmission to Thayet-myo or the stations down the river, and I am inclined to believe that coal could be conveyed cheaper by water from Pyt-tha-layn-yna to Thayet-myo than *viâ* the Northern route. The disadvantage of the Southern route is that, for some distance down, the river steamers cannot approach the bank with safety.

Secondly,—The Northern route. By this to connect the coal mine to Thayet-myo, 6½ miles of tram-road would have to be constructed: the first 2½ miles would require a liberal expenditure. For constructing and maintaining, an expenditure considerably greater than the other route, when once the coal arrives at Thayet-myo, a material advantage is obtained, *viz.*, the steamers can coal off an excellent ghaut, whilst their flats are unloading, thus saving *time*. In Htoun-doung-yna I see no advantages for a coal depôt. True, if the coal is collected at Pyt-tha-layn-yna, thence sent up by water, some expence in transit will be saved, but the steamers would have to coal off a somewhat inconvenient wharf, lose time whilst they were coaling, and consume fuel in the way to and from Thayet-myo to the depôt.

If the coal were brought by the land route to the Htoun-doung, I beg to observe, the most troublesome and expensive portion of the tram-road would have to be constructed, and the objections of loss of time, consumption of fuel, &c., would not be removed.

Taking the above into consideration, I am at present of opinion, that the best route of conveying the coal is by train to Pyt-tha-layn-yna, and from thence by water to Thayet-myo. On this subject it would be premature to offer a decided opinion.

Facilities for working.

I have hitherto, in spite of any proper tools and the drawbacks attending the employment of idle and ignorant labourers, found no difficulty in daily excavating a tolerable supply, and I am assured by Corporal Adams, of Her Majesty's

29th Regiment, and his companions, that when they are put in possession of even a small supply of proper instruments, and the horizontal gallery at which we are at work is completed, no difficulty in working the coal will be experienced, and that a large supply will daily be available.* On receiving a list of mining tools from Corporal Adams, it shall be forwarded for consideration. Supervision and labour estimates, with regard to these points, shall shortly be forwarded, together with a sketch map of the places in the neighbourhood of the mine and a rough statement of the probable expenditure required by the trains. Timber is abundant on the spot. I have every confidence that shortly coal will be supplied at Thayet-myo at Rupees 13 a ton, and that with the aid solely of the very inefficient means at my command.

I had hoped ere this that the Commissioner would have been in possession of a very much more satisfactory Report than the mere outline I now have the honor to submit, and request you will point out that other duties demanding my presence at a distance from Thayet-myo have prevented my obtaining data on which to furnish a more elaborate statement. Knowing the interest Major Phayre takes in the subject of coal, I have deemed it advisable to submit, without further delay, this bare announcement of its discovery.

The effects of my late exposure not having yet passed away, I have gladly availed myself of the proffered services of Lieutenant Ashe, of the Artillery, in drawing up the details, which I will submit with the least possible delay.

In a country like this, and with the very slender knowledge I possess on the subject, I trust the Commissioner will view with forbearance my zealous, though ill-directed, endeavours to develop the resources of that portion of the Province, in which I have the honor to serve.

I have the honor to be, &c.,

(Signed) J. S. D. WHITE, *Captain,*

Assistant Commissioner.

No. 29 A.

To

CAPTAIN WHITE,

Assistant Commissioner, Thayet-myo.

SIR,

I have the honor to forward the enclosed Memorandum relative to the coal received from you, and to state that having been pre-

* 50 tons per diem.

sent during the time it was under trial, I concur in the answers and opinion given by my Chief Engineer.

I have, &c.,
(Signed) J. M. EALES,
Commanding.

Prome;
H. C. S. Mahanuddy,
The 15th March 1855.

Q. 1*st.*—Does the coal leave much ashes after combustion?

A. Very little and that of a good color.

Q. 2*nd.*—Does it emit much smoke and gas during combustion?

A. Very little, but emits a large quantity of gas.

Q. 3*rd.*—Does it coke much during combustion?

A. A good deal, but does not clinker much.

Q. 4*th.*—Does it take fire easily?

A. It does.

Q. 5*th.*—Does it throw out a great amount of heat?

A. A large amount.

Q. 6*th.*—Does it readily crumble into dust? and any other remarks on the subject will be prized.

A. It does.

I consider the sample equal to Cherra-poonjee coal; it ignites readily, throws out a large amount of heat, does not clinker much, and leaves a very small quality of ashes. I am of opinion that it will answer admirably for steaming purposes. During the two hours' trial I found the stokers could keep up steam with the greastest ease.

Prome;
Steamer Mahanuddy,
The 15th March 1855.

(Signed) C. BOWEN,
Chief Engineer.

No. 1867.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated Fort William, the 30th May 1855.

FOREIGN DEPARTMENT.

SIR,

I HAVE the honor to acknowledge the receipt of your letter, dated the 5th instant, No. 52, forwarding copies of letters relative to the discovery by Captain White, Assistant Commissioner, of a seam of coal in a hill about 6 miles from the station of Thayet-myo.

2. In reply I am directed to acquaint you, that the Hon'ble the President in Council thinks the discovery of this coal, so far as it goes, very promising, and that every encouragement should be given to further prosecution of the search for it. The advance of Rupees 500, solicited on account of the expenses of the mining operations, is accordingly sanctioned. Care should be taken that no portion of the coal field is alienated or misappropriated, as already directed in my letter to your address, dated the 27th ultimo, No. 1486.

3. Mr. Oldham has been requested to examine and report upon the coal field, and measures have been taken for sending down by the next steamer a suitable supply of mining tools.

4. His Honor in Council will expect from you a further Report of your proceedings as soon as convenient.

I have, &c.,

(Signed) CECIL BEADON,
Secy. to the Govt. of India.

NOS. 1868 AND 1869.

ORDERED that Extract paras. 1 and 3 of the above letter be sent to the Military Department, for the issue of the requisite orders to the authorities in the Arsenal, and paras. 1 and 2 to the Financial Department for information.

No. 1870

ORDERED also that a copy of Major Phayre's letter and enclosures and of this reply be sent to the Department of Public Works, in order that it may be considered whether it is expedient to send an Engineer Officer to Thayet-myo to survey the road.

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

No. 1871.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

To

T. OLDHAM, ESQUIRE,
Supdt. of the Geological Survey.

Dated Fort William, the 30th May 1855.

FOREIGN DEPARTMENT.

SIR,

IN continuation of my letter dated the 27th ultimo, No. 1488, I am directed by the Hon'ble the President in Council to forward to you a copy of a further correspondence respecting the coal field recently discovered on the banks of the Irrawaddy, and to request that you will proceed at your early convenience to Prome for the purpose of examining and reporting upon it for the information of Government.

From Commissioner of Pegu, No. 52, dated 5th May 1855.
To Ditto, No. 1867, dated 30th May 1855.

I have, &c.,

(Signed) CECIL BEADON,
Secy. to the Govt. of India.

Fort William,
The 30th May 1855.

No. 1872.

FROM

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

G. F. EDMONSTONE, ESQUIRE,
Secy. to the Govt. of India,
With the Governor General.

Dated Fort William, the 30th May 1855.

FOREIGN DEPARTMENT.

SIR,

I AM directed by the Hon'ble the President in Council to forward, for the information of the Most Noble the Governor General, a copy of the correspondence, noted in the margin, on the subject of the discovery of a seam of coal on the banks of the Irrawaddy.

From Superintendent of Marine, No. 2434, dated 21st April 1855.
To Commissioner of Pegu, No. 1473, dated 25th April 1855.
Minute by the Hon'ble J. A. Dorin, dated 26th April 1855.
To Commissioner of Pegu, No. 1486, dated 27th April 1855.
To Superintendent of Marine, No. 1487, dated 27th April 1855.
To T. Oldham, Esq., No. 1488, dated 27th April 1855.
From Commissioner of Pegu, No. 52, dated 5th May 1855.
To Ditto, No. 1867, dated 30th May 1855.
To T. Oldham, Esq., No. 1871, dated 30th May 1855.

I have, &c.,
(Signed) CECIL BEADON,
Secy. to the Govt. of India.

Fort William,
The 30th May 1855.

No. 621.

FROM

LIEUT.-COLONEL W. E. BAKER,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated the 15th June 1855.

PUBLIC WORKS DEPARTMENT,
PUBLIC.

SIR,

WITH reference to your letter No. 52, dated the 5th ultimo, to the address of the Officiating Secretary to Government in the

Foreign Department, and its enclosures, relative to the discovery of a seam of coal in a hill not far from the station of Thayet-myo, I am directed to state, that it appears to the President in Council very desirable that a careful survey should be made of that locality as soon as possible, with a view of designing the best line of road or tram-way to the most inconvenient ghaut on the river, provided that further research shall justify the expectations now entertained, that coal can be procured in sufficient quantity to warrant the cost of such a work. I am accordingly to request that the services of Mr. Login, lately appointed to Pegu, may if possible be made available for this duty. In the event of your reporting that Mr. Login is already occupied with other and more important duty, endeavours will be made to depute a competent surveyor from Calcutta.

I have the honor to be, &c.,

(Signed) W. E. BAKER, *Lieut.-Colonel,*
Secy. to the Govt. of India.

No. 24 A.

FROM

THE SUPDT. OF THE GEOLOGICAL SURVEY,

To

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India.

Dated the 4th June 1855.

SIR,

I HAVE the honor to acknowledge the receipt of your letter, No. 1488, dated 27th April, and giving cover to correspondence relative to the discovery and trial of some coal from the neighbourhood of Thayet-myo on the Western bank of the Irrawaddy River, and requesting me to report what steps were desirable, with a view to a careful examination and survey of the locality.

Having on the day previous to the receipt of your letter returned from the Southern Districts of the Tenasserim Provinces, after a careful examination of all the known coal-yielding localities there, it appeared to me to be most desirable to visit the Thayet-myo locality at once ; but as

the monsoon had already set in with great force at Moulmein, I immediately placed myself in communication with Major Phayre, Commissioner of Pegu, and after a consultation with him, I have made the following arrangements in anticipation of the sanction of the Government of India, and I trust the plan will meet the approbation of the Hon'ble the President in Council.

Mr. Wm. Theobald, one of my Assistants, will proceed by the earliest opportunity (in a few days) to the district in which the coal has been found, and make himself thoroughly acquainted with the details, visiting all the localities; and I shall myself subsequently join Mr. Theobald there and re-examine the principal points. I shall take advantage of the interval to proceed to Calcutta, in order to have some instruments, which have been injured during the very jungly work of the past season, repaired, and to obtain some others which will be required during the visit of Major Phayre to Ummeerapoora (to whose party the Hon'ble the President in Council has done me the honor to attach me,) arrangements which I should not have been able to perfect previously to the time named for Major Phayre's departure in any other way. I confidently hope, therefore, to be able to lay before the Government of India a Report on the District of Thayet-myo before the close of the ensuing month. The rainy weather will unquestionably interfere somewhat with our labours, but as I am led to hope, not to any material extent.

Should these arrangements meet the sanction of the Hon'ble the President in Council, I have to request that the authority granted to the Commissioner of Tenasserim and Martaban Provinces, to make advances to me for the current expenses of the Geological Survey, to the extent of Rupees 1,500 per month, may be extended to the Commissioner of Pegu, such sums being subsequently adjusted in the same manner as hitherto.

I have the honor to be, &c.,

(Signed) THOMAS OLDHAM,

Supdt. of the Geological Survey.

Rangoon,
The 4th June 1855.

No. 2339.

FROM

J. W. DALRYMPLE, ESQUIRE,
Offg. Under-Secy. to the Govt. of India,

To

T. OLDHAM, ESQUIRE,
Supdt. of the Geological Survey.

Dated Fort William, the 29th June 1855.

FOREIGN DEPARTMENT.

SIR,

IN reply to your letter, dated 4th instant, No. 24 A., I have the honor to convey the sanction of the Hon'ble the President in Council to the arrangements mentioned therein, with a view to a careful examination and survey of the coal field recently discovered on the banks of the Irrawaddy, as also to your coming to Calcutta, in order to have some instruments repaired and to obtain others.

2. I am at the same time to acquaint you, that the necessary orders will be issued from the Financial Department, authorizing the Commissioner of Pegu to permit your drawing, to the extent of Rupeess 1,500 per mensem, for the current expenses of the surveying party, the amount to be adjusted in the same manner as hitherto.

I have the honor to be, &c.,

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

No. 2340.

ORDERED that a copy of the above correspondence be sent to the Financial Department, for the issue of the necessary orders, in continuation of orders dated 22nd December last, No. 5381.

(Signed) J. W. DALRYMPLE,
Offg. Under-Secy. to the Govt. of India.

GOVERNMENT No. 64 OF 1855.

No. 13, GENERAL.

FROM

MAJOR A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.,

TO

CECIL BEADON, ESQUIRE,

Secy. to the Govt. of India,

Offg. in the Foreign Department.

Dated Rangoon, the 29th May 1855.

SIR,

WITH reference to your letter to my address, No. 1486, dated the 27th ultimo, and in continuation of my letter, No. 52-10 dated 5th May 1855, relative to the coal discovered near Thayet-myo, I have now the honor to submit, for the information of the Hon'ble the President of the Council of India in Council, copies of letters as noted in the margin, containing further Reports upon that subject.

From Captain White, Assistant Commissioner, to Captain Ardagh, Deputy Commissioner, Prome, No. 194, dated 18th May 1855, with Sketch Map H. A.
From the same to the same, No. 199, dated the 22nd May 1855, with Map Z.

2. Captain White describes his proceedings on the first discovery of the coal, and the progress of the miners in working the gallery through the hill to strike the vein of coal below the surface. He also explains how he proposes to convey the coal by tram-way to join an existing road leading to the village of Py-tha-lying* on the Irrawaddy, a distance of about 2 miles from the coal mine. Eventually the tram-way would be constructed the whole way to Py-tha-lying, where there is convenient anchorage for steamers to receive it. A wharf should also be built there for facilitating the loading of boats and steamers. The expense of the tram-way, as far as the point D., including purchase of carts and bullocks, sheds for the coal and miners' houses, &c., is put down at Rupees 3,945. As Captain White will hardly be able to undertake the details of this work himself, I beg to recommend that some person accustomed to such works may be sent for the purpose of superintending the laying down of the tram-way with artificers for the construction of the wains, &c.—in the meantime

* *Vide* Map Z.

I beg to solicit sanction for the purchase of bullocks and carts and the hiring of drivers as recommended by Captain White.

3. With reference to the mining establishment recommended by Captain White, there are now four European miners kindly allowed to work by Colonel Smith, commanding Her Majesty's 29th Regiment. I would beg to suggest that these men be continued on for the present, until the Report of the survey of this coal field shall have been rendered, when the full establishment required can be safely estimated. But a few native miners from Bengal, if sent at once with their tools, would be of great service. Captain White recommends the sum of Rupees 50 a month for the European miners. I am unable to give an opinion as to whether this sum is a fair amount of wages for English miners in India if in regular employ, but the four men from Her Majesty's 29th Regiment, hitherto employed, have worked so well under all the disadvantages of bad tools, heat of weather, and little or no native assistance, that I beg they may be allowed each that sum from the period they first commenced work and until some permanent arrangement of the establishment be made.

4. Captain White has already indented for tools for the workmen now employed, so I need request nothing on that head, but I trust that the Hon'ble the President of the Council of India in Council will permit me to apply to the Major General Commanding the Pegu Division for the services of about twelve sappers, as recommended by Captain White for the construction of the inclined way.

5. I beg to bring to the notice of the Supreme Government the very creditable exertions of Captain White in the discovery of this coal, and in designing a plan for making it available. Care has been taken to carry out the orders received to prevent the alienation or misappropriation of any part of the coal field. The land under which it is found is unoccupied waste, and has no proprietor as I am at present informed. I have directed a special Report to be made on this point, which, when received, I shall have the honor to address you hereafter.

I have the honor to be, &c.,

(Signed) A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.

GENERAL No. 199.

To

CAPTAIN ARDAGH,
Deputy Commissioner, Prome.

Thayet-myo, the 22nd May 1855.

SIR,

WITH reference to my general letters, Nos. 187 of the 29th ultimo, and 194 of the 10th instant, I now have the honor to submit for Major Phayre's consideration a summary of the information I have up to date been able to glean on the subject of the Thayet-myo coal. There are points on which I touch with great diffidence, as they more properly belong to the department of the practical engineer and require time to fairly elucidate.

On first discovering indications of coal, I directed a simple trench to be excavated in the direction the coal vein appeared to run (N. E. and by N. S. W. and by S.) The symptoms at first were discouraging, but we persevered, and at a depth of 12 feet struck the true coal. From this trench all the sample fuel hitherto submitted has been taken up.

It was apparent however that this method of working the coal was out of the question, for not only would the mere fall of rain have filled our open trench, but just at the spot where the coal cropped out, the courses of two hill torrents poured their united drainage of the heights. Consequently, with the assistance of five miners from Her Majesty's 29th Regiment, I re-commenced operations round the spur of the hill, by driving a gallery to meet the coal vein at a right angle. In spite of the obstacles offered by the extreme hardness of the rock, the work has progressed most favorably,* and I am happy to say without the slightest accident.

The tools the miners have had to work with are very indifferent and scarcely adapted to the purpose, but by the aid of small blasting charges, all difficulties have been overcome and we are now within two yards of the coal vein—the rock is passed, and the fire-clay reached—in two more days the vein will be laid bare.

Having reached the coal, it has to be considered how, when excavated, the fuel is to be conveyed to the river bank.

I now beg to submit a sketch of the hills in which the coal is found (Z) and the roads connecting it with the river bank.

---

* The gallery is now 50 yards in length.

I originally proposed making a cutting for a road on the hill-side just above the pathway (C. C. C.,*) but on further inspection found it would be very expensive and laborious, besides being liable to be cut away by the rush of water. I therefore determined to convey the fuel to the road-way by the path leading from the gallery A. to the miner's house B. Between these spots a rugged ravine intervenes and the hill-side leading to the house is somewhat steep. I propose overcoming these difficulties by constructing a stout wooden bridge across the ravine from the materials on the spot.

From the bridge an incline of 240 yards carries us to the crest of the small hill on which the house B. is situated.

On this incline I propose laying down wooden tram-ways on which the coal veins may run. A wooden drum, with a diameter of 6 feet, will be constructed on the hill crest. On this a stout hawser is to be worked by bullocks.† By this means a cart, with half a ton of coal, can be dragged up without difficulty each trip.

From B. a road (marked in the plan thus —— / "—— / "—— /) can be constructed without much expense or difficulty, to join the excellent natural road at the hill foot.

It would be desirable to have a tram-way laid down the whole way on this road to Py-tha-layn, but I have not yet had time to devote to the preparing an estimate of its probable cost. It would however be comparatively trifling, as the road is quite level, and abundance of wood adapted for the purpose is on the spot. On a tram-way the bullocks could drag twice as much as on the common road.

The breadth of the coal vein is put down at 4 feet. The following rough estimates are made on the basis, that six tons of coal per diem would be excavated. Hereafter I opine the amount might be very

* This is a mere passage in the bed of the torrent covered with large boulders.

† If they could be spared, two elephants would be preferable, or one of the animals with the assistance of the drum.

largely increased. Circumstances and experience will doubtless modify the items.

Dr.

Probable Primary Outlay.	Rs.	As.	P.	Rs.	As.	P.	
Tools for working the coal. Having no data on which to go, I cannot venture as to their probable cost,..	0	0	0				
Constructing a bridge to connect the coal gallery with the hill B.,.....	180	0	0				
Cutting an incline from the bridge to the crest of the hill B.,*	250	0	0				* This could be done cheaper and better if the services of a few sappers could be spared.
Laying down a tram-way on the above incline, ...	230	0	0				
Constructing a wooden drum, on which the hawser is to work, ...	100	0	0				
To four wains to work on the incline, at 200 each, ...	800	0	0				
To constructing a road-way from B. to D., ...	600	0	0				
A slight extra expense would be required on the road to Py-tha-layn, say, ...	300	0	0				
To the purchase of 10 carts and 10 pair of bullocks for conveying the coal to the river bank, at Rupees 50 each, ...	500	0	0				
To the purchase of 3 pair of bullocks for working the drum, at Rupees 45 each pair,.....	135	0	0				
To constructing houses for the miners and coolies employed, ...	500	0	0				
Sheds for bullocks,.....	150	0	0				
Sheds for the coal at Py-tha-layn, ..	300	0	0				
				4045	0	0	
Probable Monthly Expenditure.							
To one Head European Miner,*	80	0	0				* This sum would have to be increased if the man had no other emoluments save his wages.
„ four European miners, at Rupees 50 each,.....	200	0	0				
„ ten coolies, at Rupees 7 each,....	70	0	0				
„ eleven bullock-drivers, at Rupees 8 each, ...	88	0	0				
„ a Superintendent of coal stores and account keeper,.....	150	0	0				
„ feeding 11 pair of bullocks, at Rupees 4 per pair, ...	44	0	0				
„ wear and tear and repairs,†.....	100	0	0				† This item experience must determine.
				732	0	0	
				4777	0	0	

Cr.

	Rs. As. P.	Rs. As. P.
Monthly value of fuel, ...	0 0 0	
Excavated.		
To six *tons* of coal per diem, 28 maunds to the ton = 168 maunds, at 10 annas per maund = monthly for 25 working days in the month,	.....	2625 0 0

I beg the Commissioner will take into consideration the circumstances under which the above estimates are submitted and the difficulties I have had to encounter (from my own inexperience in such matters) in framing them.

As some apology for the delay in forwarding these details, I would beg to plead the other arduous duties that have lately occupied me, and remove me from this neighbourhood.

Inaccuracies will doubtless appear in these Reports, and my crude details I fear will afford but a slender guide to those in authority. To any theoretical knowledge or scientific arrangement of the subject I do not pretend, but simply aspire to be considered the pioneer in a discovery which in the hands of others better fitted for the task, I earnestly trust may prove of some benefit to this Province.

I have the honor to be, &c.,

(Signed) J. S. D. WHITE, *Captain*,
Assistant Commissioner.

GENERAL NO. 194.

To

CAPTAIN ARDAGH,
Deputy Commissioner, Prome.

Thayet-myo, the 18th May 1855.

SIR,

I HAVE the pleasure to acknowledge the receipt of your general letter, No. 199, enclosing a demi-official communication from Mr. Berry, Superintendent of the Dock-yard at Rangoon, on the subject of the coal found near Thayet-myo.

I have twenty bags of coal ready for transmission by the next steamer; this fuel has been taken promiscuously from a heap now on the river bank.

In reply to the queries of the Commissioner I have the honor to state—

First,—Corporal Adams and the other European miners assure me the two veins united will be between 6 and 9 feet broad, but with all

due deference to their practical experience, I deem it advisable not to rate the vein at a greater breadth than 4 feet—at the same time I have little doubt that Corporal Adams is right in expecting to find other veins close to the one on which we are at work.

Secondly,—I beg your attention to the accompanying rough sketch A., by which you will perceive that the coal cropped out on a spot where two water-sheds unite. On this spot I commenced experimental operations by simply digging an open trench, but it will be apparent that when rain falls this trench will be entirely filled with water. It has therefore been necessary to commence a shaft round the shoulder of the hill, as shown at A. B. of the sketch. This shaft will be about 40 yards long. Our progress, however, is very operose from the extreme hardness of the sand-stone through which we have to work. Whilst driving this shaft we have come upon iron ore of superior quality, but in small quantity. The miners are confident that it will be found to a considerable amount. I trust this may be the case, but hardly dare hope for so fortunate a result.

Thirdly,—I beg to attach a List of Tools required (B); many of these I hope shortly to obtain; Brigadier Lane, C. B., Commanding at Thayet-myo, having, with great consideration, forwarded an indent for me under his own signature to the Arsenal at Rangoon or Fort William.

I have further the pleasure to forward a Sketch Map (C.) of the hills in which the coal is found, and the roads leading from Thayet-myo and Py-tha-layn to the mine. I have to thank Lieutenant Oakes, of the Madras Engineers, for this Map.

Z.
(Sd.) A. P. P.

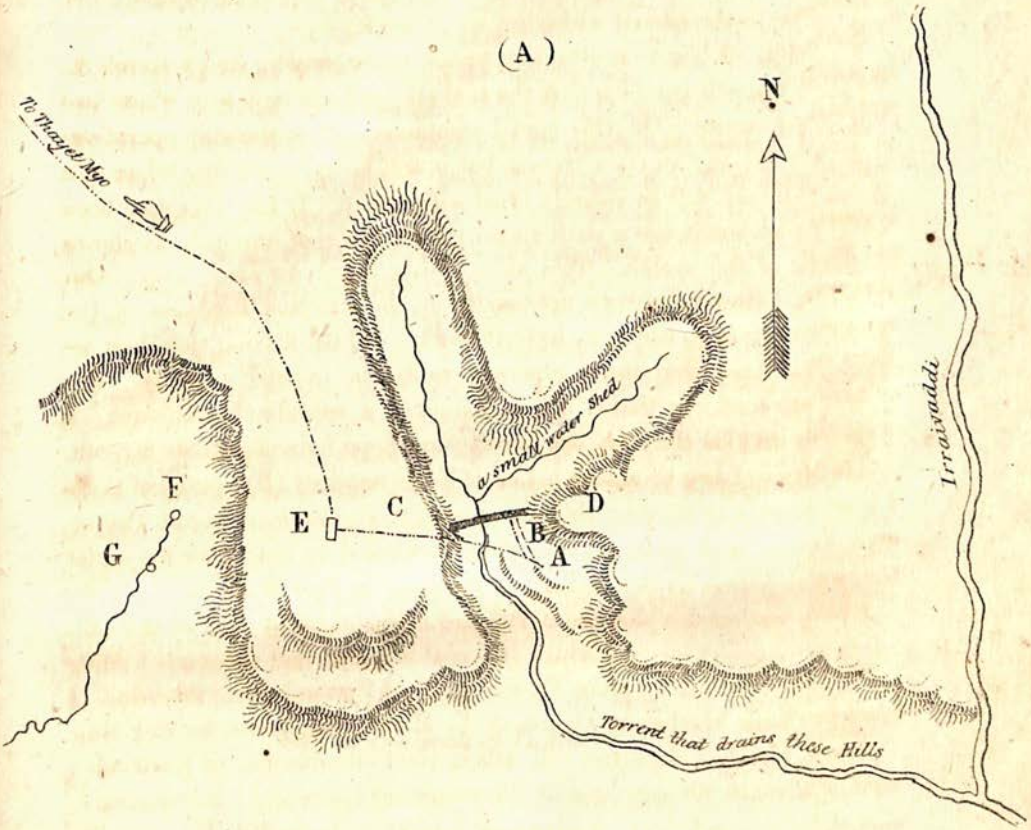
I now, Sir, beg that you will solicit the Commissioner to grant me a further advance for carrying on these mining operations; the sum sanctioned by you and the Commissioner, has been expended, but deeming the working of this coal of such great importance, I have taken upon myself to continue the operations. When once we strike the coal vein, not only will it pay its own expenses, but very speedily repay any advance made on its account.

Up to date we have only succeeded in inducing four Burmans to work in the shaft; the generality of them view with considerable suspicion the progress of a work, the purport of which they cannot comprehend. I am happy to add, however, that labourers are gradually getting less afraid of approaching the mine.

I have, &c.,

(Signed) J. S. D. WHITE, *Captain*,
Assistant Commissioner.

(A)



A B *Shaft now being driven into the hill to meet the Coal vein*

C D *Coal vein first discovered & worked slightly as an Experiment*

E *Small Bungalow for Miners*

F *Mineral Spring*

G *Spring slightly impregnated with iron.*

(Sd) *J. S. D. White Captn*

Assistant Commissioner

T. Black, Asiatic Lith. Press Cal.

List of Articles required for the Coal Mine near Thayet-myo.

One complete set of Blasting Tools.
12 Still Wedges, of 2 lbs. weight each.
12 Iron Wedges, of 4 lbs. weight each.
12 Straight Picks, 2 feet long, 3 lbs. weight each.
12 Straight Picks, 20 inches long, 3 lbs. weight each.
12 Stone Picks, 6 lbs. weight each and 20 inches long, curved 4 inches.
2 Hatchets, 7 lbs. weight, 7 inches broad and 9 inches deep in the blade.

(N. B.—For hewing timber for the gallery frames.)

3 Sledge Hammers, 14 lbs. weight, 8 inches long, flat ends.
3 Ditto, 9 lbs. weight, 1 foot long.
2 Safety Lamps.
12 Shovels.

(Signed) J. S. D. WHITE,
Assistant Commissioner.

No. 2366.

FROM

C. BEADON, ESQUIRE,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated Fort William, the 3rd July 1855.

FOREIGN DEPARTMENT.

SIR,

I AM directed to acknowledge the receipt of your despatch, dated the 29th May, No. 64, submitting two letters from Captain White, respecting the coal field lately discovered in the vicinity of Thayet-myo, and recommending various measures for working the same.

2. In reply I have to acquaint you, that the Hon'ble the President in Council sanctions the outlay of Rupees 3,945 for the tram-way pro-

posed to be constructed to facilitate the transport of the coal for the purchase of carts and bullocks and for the erection of sheds and other buildings. Captain White may also be instructed to engage the necessary drivers and other workmen at once.

3. Application has already been made to the Department of Public Works for the services of an Engineer Officer if available.

4. For the present you are authorized to continue to employ the four men from Her Majesty's 29th Regiment as miners and to pay them the salaries proposed of Rupees 50 each, commencing from the date they were placed at your disposal. If the services of native miners can be procured, they will be engaged and sent down as early as possible.

5. The requisite tools have already been forwarded, and with regard to your application for twelve sappers, I am desired to say that the Major General Commanding the Pegu Division will be addressed on the subject through the Military Department.

6. Your future communications in all matters connected with the coal mine should be addressed to the Department of Public Works.

I have the honor to be, &c.,

(Signed) C. BEADON,

Secy. to the Govt. of India.

No. 2367.

Extract from the Proceedings of the Hon'ble the President of the Council of India in Council, in the Foreign Department, under date the 3rd July 1855.

READ a letter from the Commissioner of Pegu, No. 64, dated 29th May (para. 4,) requesting the services of twelve sappers to help in constructing a tram-way from the coal field discovered near Thayet-myo.

Ordered that the Military Department be requested to communicate with the Major General Commanding the Pegu Division on the subject of this application.

(True Extract)

(Signed) C. BEADON,

Secy. to the Govt. of India.

GOVERNMENT No. 121 OF 1855.

FROM

MAJOR A. P. PHAYRE,
Commr. of Pegu and Agent to the Govr. Genl.,

To

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,
Offg. in the Foreign Department,
Fort William.

Dated Rangoon, the 4th July 1855.

No. 22, GENERAL.

SIR,

I HAVE the honor to acknowledge the receipt of your letter, No. 1486, of the 27th April last, and in reply beg to annex a copy of the correspondence noted in margin.

Deputy Commissioner, Prome, to Commissioner of Pegu, No. 273, 20th June 1855.
Assistant Commissioner, Thayet-myo, to Deputy Commissioner, Prome, No. 223, 14th June 1855.

2. Captain White, it will be seen, declares his inability to state the extent of the coal fields, and it appears that no proprietary right can exist in the soil overlaying it.

I have the honor to be, &c.,
(Signed) A. P. PHAYRE,
Commr. of Pegu and Agent to the Govr. Genl.

Pegu Commissioner's Office;
Rangoon,
The 4th July 1855.

No. 273, GENERAL.

To

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

SIR,

I HAVE the honor to annex copy of letter No. 223, General, from Captain White, Assistant Commissioner, Thayet-myo, on the subject of the coal bed at Thayet, in reply to your letter No. 110 of the 22nd ultimo.

I have, &c.,
(Signed) R. D. ARDAGH,
Deputy Commissioner.

Prome,
The 20th June 1855.

To

CAPTAIN ARDAGH,

Deputy Commissioner, Prome.

Thayet-myo, the 14th June 1855.

No. 223, GENERAL.

SIR,

I HAVE the honor to acknowledge the receipt of your general letter, No. 234, of the 2nd instant, forwarding copies of documents noted in the margin.

No. 1486, from the Secretary to Government to Major A. P. Phayre, Commissioner and Governor Geneal's Agent in Pegu.
No. 110, from Major A. P. Phayre to Captain R. D. Ardagh, Deputy Commissioner, Prome.

With reference to the letter from the Secretary to the Government of India to Major Phayre, Commissioner and Governor General's Agent in Pegu, calling for further information regarding the Thayet-myo coal, I have the honor to state that perhaps my Reports will ere this have supplied the information required, with the exception of as to the extent of the coal bed and any proprietary right that may exist in the soil overlaying the coal.

I am quite unable to state to what extent the coal may be found. This I opine would require a carefully executed survey by persons deeply conversant with the subject. The lands at the coal mine, and for some distance in its neighbourhood, have never been used for any save Toungyah cultivation; and if I am not mistaken, such temporary occupation—the Toungyahs being changed every year—bestows no right to a permanent ..... on the soil—in fact no such pretension has been put forward.

I have, &c.,

(Signed) S. D. WHITE, *Captain,*

Assistant Commissioner.

GOVERNMENT No. 67 OF 1855.

FROM

MAJOR A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.

To

LIEUT.-COLONEL W. E. BAKER,

Secy. to the Govt. of India,

Public Works Department,

Fort William.

Dated Rangoon, the 11th July 1855.

No. 93, D. P. W.

SIR,

I HAVE the honor to acknowledge the receipt of your letter No. 621, dated 15th ultimo, and in reply to state, that Mr. Login had, at my request, commenced to take the levels of the whole cantonment, town, and suburbs of Rangoon. He has accomplished a good deal of this important work, but from the constant rain at this season, he considers what remains may be more advantageously carried on when the weather has moderated. Mr. Login is also desirous of seeing the Irrawaddy River when in high flood, and I have therefore directed him to proceed at once up the river to the coal field near Thayet-myo, and there make a careful survey of the locality as directed in your letter under reply.

I have the honor to be, &c.,

(Signed) A. P. PHAYRE,

Commr. of Pegu and Agent to the Govr. Genl.

Pegu Commissioner's Office;
Rangoon,
The 11th July 1855.

No. 1276.

FROM

LIEUT.-COLONEL W. E. BAKER,
Secy. to the Govt. of India,

TO

MAJOR A. P. PHAYRE,
Commissioner of Pegu.

Dated the 17th August 1855.

PUBLIC WORKS DEPARTMENT.
PUBLIC.

SIR,

IN reply to your letter Nos. 67-99, dated the 11th ultimo, I am directed to state, that the Hon'ble the President in Council approves of your having directed Mr. Login to proceed to the coal field near Thayet-myo with the view of making a careful survey of that locality.

I have the honor to be, &c.,
(Signed) W. E. BAKER, *Lieut.-Colonel,*
Secy. to the Govt. of India.

Fort William,
The 17th August 1855.

No. 27.

FROM

THE SUPDT. OF GEOLOGICAL SURVEY,

TO

CECIL BEADON, ESQUIRE,
Secy. to the Govt. of India,

Dated the 4th August 1855.

SIR,

I HAVE the honor to report, for the information of the Hon'ble the President in Council, that in accordance with arrangements previously sanctioned, immediately on my return to Rangoon, I proceeded to this Station, and commenced an examination of the coal deposits in this neighbourhood, which had been brought to light through the exertions of Captain White, Assistant Commissioner. This had been previously visited by Mr. Theobald, my assistant, and partially examined, and I have the honor to submit herewith the results of my research.

It is with great regret, that I have been compelled to advise the stoppage of any further work here, for although at first I was sanguine as to the result, and trusted that the persevering enquiries of Captain White would be fully rewarded, further examination has not confirmed these hopes. The cause of this I have endeavored to make clear in the accompanying Memorandum.

I have to express the obligations we are under for the friendly co-operation and assistance we have received from all the authorities here, both Civil and Military.

I have the honor to be, &c.,
(Signed) THOMAS OLDHAM,
Superintendent of Geological Survey.

Thayet-myo,
The 4th August 1855.

MEMORANDUM ON THE COAL FOUND NEAR THAYET-MYO ON THE IRRAWADDY RIVER.

Position.—The Station of Thayet or Tharet-myo is situated on the right bank of the Irrawaddy River, in North latitude 19° 21′ 36″, about 30 miles North of the large town of Prome and about 11 miles South of the boundary of the British Territories. The village and cantonments are pleasantly situated near the centre of an extensive and gently undulating plain, bounded on the East by the river bank, and the limits of which, to the North, are defined by the small range of hills, which are opposite to the Cantonment of Meeaday, and to the South by a second and very similar range which stretches from the Irrawaddy in a North-westerly direction for about 4 miles, between the villages of Pya-tha-ling on the South and Toung-doung on the North. It is in this latter range, and on the North-western slope of the hills, that the coal has been found. This range nowhere rises to a greater elevation than 800 feet and its average height is considerably less.

Geology.—The undulating plain about Thayet-myo is formed entirely of sand and gravel, similar to, and a continuation of, that which is seen well exposed in the banks of the Irrawaddy at the Station. This gravel is composed, principally, of much rolled and rounded pebbles of quartz, of many varieties of granites, hard siliceous slates, and nodules of ferruginous sands. In it are found numerous and occasionally very large

masses of silicified wood (chiefly, though not exclusively endogenous,) and though rarely of fossilized bones. It occurs in regular layers associated with sand, and occasionally with earthy shaly beds, dipping at low angles to the North and North-west, although for the most part loosely aggregated, and slightly coherent, the sands and gravel are occasionally found cemented into hard conglomerates and sand-stone, by the peroxide of iron, forming a dark-red ferruginous bed.

Passing over these for some three miles in a South-west direction from the Station of Thayet-myo, the road gradually rises over low spurs from the general range, which are composed of grey and greyish-blue shaly beds, with intercalated layer of hard calcareous sand-stones, often nodular in structure. The clayey beds themselves frequently become clunchy also. Of this series there is a thickness of about 400 feet. The beds dip at angles from 25° to 30° to N. 25° E. and N. 30° E., and are therefore quite unconformable to the overlying beds of gravel and sand, which appear to be of much more recent date.

Below these earthy beds are sandstones, soft, brownish and earthy, with very hard calcareo-siliceous layers, often containing well preserved fossils, and frequently one mass of comminated fragments of shells. These have a thickness of about 150 feet.

Under these again come regularly deposited flaky beds of brownish earthy sand, with a few hard layers, exhibiting a repetition of the same conditions throughout their entire thickness, which is not less than 300 feet.

These rest upon lime-stone, which has a thickness of 70 feet in parts, but is not very regular. This, by its hardness and consequent prominence, form the summit of the ridge. It is of a light grey colour, hard and compact, full of minute fossils *(foraminifera,)* fragments of shells, corals, &c. Some of the beds are massive, others more flaky, and separated by thin earthy partings. The whole, as are also the beds of sand-stone, &c. above, is of marine origin.

This lime-stone is here largely used for the manufacture of lime, being burned in kilns in the neighbourhood of the hills or on the river bank, and thence exported. The mode of obtaining the stone is simple enough, but effective. I have mentioned that it occurs forming the summit of the ridge, and from this the loosened blocks are shot down the steep slopes of the hill-side, soon forming a clear course for themselves, and are collected at the base and carted away. Several of these deep

scarfings, along which the lime-stone is thus delivered, can be seen on the hill face from the Station of Thayet-myo.

Under the lime-stone again occur soft earthy beds of brownish clunchy clay in regular layers, then sandstones, loose and pebbly, of a reddish tint, then clunchy clay of grey and blue grey colour, with harder and more sandy layers, and a few thin nodular beds of earthy ferruginous character. In this portion of the series the coal bed occurs.

Below this is a hard grey sand-stone, with occasional carbonaceous markings resting upon sandy clay beds in irregular layers; altogether these have an aggregate thickness of about 300 feet, and rest upon brownish sand-stones and pebbly beds with layers of conglomerate, abounding in false bedding, and very irregularly associated. Of these some 250 feet in thickness are seen, and these continue to the base of the hill at the South side.

Another wide plain of irregular undulating ground here stretches for miles, and in it, as in that of Thayet-myo, the more recent deposits of gravel and sand waste all the older series.

Coal.—The coal, where it has been opened upon, is situated on the slope of the hill facing this plain, about 300 feet below the top of the ridge in that part. It was first found exposed in the bed of a small ravine, or mountain stream, which is quite dry, excepting immediately after rain. This small ravine, and of course the two spurs bounding it on either side, runs nearly due North and South.

Immediately at the coal, the section of the rocks was as follows:—

	Descending. Ft.	In.
Clunchy clay, greyish blue, with a few harder layers.		
Black carbonaceous shaly beds, with streatis of coal,	0	9
Coal, with a few thin earthy partings,	4	0
Coaly shale, earthy and carbonaceous,	0	5
Clunchy clay, grey,	3	0
Ferruginous nodular layer,	0	3
Clunchy clay,	1	1
Coal, flaky and laminar,	1	2
Clay, earthy and nodular,	1	8
Sand-stone, hard, grey, with white mica and occasional carbonaceous markings,	10	0
Grey clunchy clay or shale.		

From this it will be seen that there appeared two distinct beds of coal just here; the lower of one foot in thickness and the upper of about 4 feet of coal.

108414

The whole series of rocks described above, and which form one unbroken and conformable sequence of deposit, dips to the N. N. E. In the upper beds the amount of inclination is not more than 25°, but this gradually increases as we descend in the series; the lime-stone, the coal itself, and the associated beds being at angles from 75° to 85°, or nearly vertical.

In structure this coal is flaky and laminar, composed of alternating layers of bright jetty coal and dark dull earthy carbonaceous shale. In specific gravity, it varies from 1-2 to 1-35. It lights with some facility, burns with good bright and abundant flame, does not intumesce or coke to any extent, the fragments to a great extent retaining their form and burning into hard red cinders, does not clinker, and leaves only a small proportion of ash in *powder*. By a comparative trial of this coal with Raneegunge coal and English, it was found fully equal, if not superior, to the ordinary Raneegunge coal as to its rate of burning or endurance, and decidedly superior in the relative amount of ashes and cinder left after combustion. In this Thayet-myo coal 35·00 per cent. of ash and cinder remained, in the Raneegunge coal 46·6 per cent. These trials were made with the furnaces of the small punching and dulling engine used in the Dock-yard, Calcutta, and under the superintendence of Mr. Jones, the Chief Superintending Engineer, and the details as given by him are quoted below.*

Whatever its real comparative value may have been, for determining which fairly, such a limited experiment was not by any means sufficient, it was obvious that the coal here found was of sufficiently good quality for

* *Statement of trial of Coal sent from Rangoon Naval Dock Yard, by the Chief Superintending Engineer, against Raneegunge and English Coal.*

Coal.	Quantity experimented upon.	Commenced burning.	Consumed at	Time of burning.	Ashes left.
	Mds. Srs.	A. M.	P. M.	H. M.	Mds. Srs.
From Rangoon, ...	2 23	10 20	1 40	3 20	0 36
„ Raneegunge, ..	2 23	9 53	1 10	3 17	1 8
„ English, ...	2 23	10 20	2 45	4 25	Scarcely any.

use in the steamers now plying in the Irrawaddy and for the sea-going steamers now trading to Rangoon. While the general importance of a good supply of coal, as connected with the successful navigation of the river, and with the practical development of the resources of British Burmah, could scarcely be too highly estimated.

Under this impression, and with such favourable and promising appearances as I have mentioned, Captain White, Assistant Commissioner at Thayet-myo, had first excavated to the depth of some feet on the beds of coal, where they were exposed on the surface, and had obtained from this excavation some good coal. The report on this was so favorable, that he sought for and obtained the assistance of five men of H. M.'s 29th Regiment, now stationed at Thayet-myo, who had been practically engaged in mining in England and Wales, and whose acquaintance with such operations was of essential service.

A gallery or drift-heading was now commenced a little way down the slope of the hill, with a view to cut the coal below. This was driven in for about 36 yards, when the coal was reached. It is only just to add, that these men, who were under the charge of Corporal Adams, did their work remarkably well. Their progress was undoubtedly slow, but this must be in a great measure attributed to the tools procurable at Thayet-myo, and which were very badly adapted for such operations. Trenching tools may be excellent for their own peculiar purpose, but are not by any means fitted for under-ground work in small headings, nor were any smiths available who could make others.

The advantages of its position also were such as to justify an anxious expectation that the coal would turn out well. From the base of the hill, on which it occurred, to the bank of the Irrawaddy, at Pya-tha-ling, the distance was not more than two miles. For the entire way, there is now an old road used for carting timber and lime-stone, which passes over very favorable ground, and which, for all practical purposes, may be considered a perfect level. There are no streams to cross requiring bridges, and the road could be cleared and put in order for a very trifling sum. The descent from the level of the out-crop to this road is steep, (about 220 feet,) but is over favourable ground, the natural inclination of which is not too great and is continuous and nearly equable. Down this a rude train-road could be very economically constructed, which might easily be worked, either by self-acting inclined planes, or by a drum worked by a pair of oxen. To the head of this incline, the coal

could be brought on a level from the mouth of the mine. For all purposes for which timber could be required in the course of these operations, there is abundance in the immediate vicinity, which could be procured for the expense of cutting, and I think there can be no question that coal, if it existed in this locality, could be worked very economically.

The position of the beds was undoubtedly objectionable. Their nearly vertical arrangement would have necessitated the seams being worked in regular galleries, like a metallic mine; but this would at the same time have facilitated the unwatering of the works, and the presence of "sulphur" (in parts abundant) was another drawback. But although strong, these objections were not sufficiently so to outweigh the advantages.

There remained then the main question to determine the probable quantity of coal which existed, and the chance of the continuity or permanence of the beds seen at the surface.

When I first visited the place, the excavation which had been originally made, had partly fallen in, and the pit was filled with rubbish and water, so that I could not see clearly the bed, and at that time the under-ground gallery had not reached the coal. There was above a slight appearance of the two beds gradually approaching each other by the thinning out of the intervening beds of clay, &c., but the face of the thicker bed, as then visible, was very promising, and notwithstanding some doubts founded on the analogy of similar rocks elsewhere, I was sanguine that there would be found a good and useful bed of coal, and I was confirmed in this hope, by finding that in a few days afterwards the coal was cut in the heading *precisely* where from measurement I had anticipated it would be. This was the smaller or lower bed, and I then concluded that the other would be found in its relative position within a few feet. I was obliged to leave the place for Prome, and on my return in a fortnight was surprised to find that the miners had gone through all the coal, without recognizing it, and had driven on for some twelve yards farther in the clunch clay. On examination of the pit, however, the facts of the case became obvious. The two distinct beds, which at the surface was seen to be separated by nearly 4 feet 6 inches of clay, &c., had at this depth, about 14 feet below the surface, been brought within 12 inches of each other, while the beds of coals themselves had dwindled down to less than half their thickness. The

thicker bed, which above was 4 feet, was here only 1 foot 8 inches, and the 1-foot bed seen above was here only 5 inches thick. The whole was broken up by several little slips nearly E. and W., and underlying to the N. E. at 80°. Finding this remarkable diminution in the thickness of the beds in depth, a closer examination of the beds at the surface was again made. A small heading was driven on the thicker bed of coal for some feet, and the general character of the deposit thus seen, there too, the greatest irregularity was found. The best seams of bright coal were found suddenly stopped off by masses of clay imbedded in the general seam, or forming lenticular masses in the coal; layers which in one place were bright jetty coal passed within a few inches space into earthy shale; and the whole bed, which when first seen looked a very promising bed of 4 feet in thickness, was broken up into thin and irregular patches of coal mixed with clay. The opposite or Northern end of the excavation was now cleared away. This was about fifteen feet horizontally from the other face, and within that distance I found that the bed, which before appeared to be 4 feet in thickness, was reduced to 2, and was friable poor coal.

I had, in the general examination of the neighbourhood, traced the extension of these coal seams across the spur of the range to the South of the first openings and into the bed of a small mountain stream there, and this I now had opened sufficiently to see the seam, which, however, proved to be only 9 inches in thickness, and therefore useless.

Finding, therefore, that notwithstanding the very promising appearances which were at first presented, and which were certainly very deceptive, that these beds of coal, within the short distance of 15 feet in depth and 15 feet in length, had been reduced to a thickness less than half their original size, and had further become so intermixed with clay and earthy matter as to be useless. I have been reluctantly compelled to advise the abandonment of the works.

As regards the extension of these beds the connection of the coal with the lime-stone above enables us to trace the probable area over which these beds extend, even where there is no actual exhibition of the beds themselves on the surface. To the North of the position of the present excavation, the lime-stone and other beds are curved round gently in the line of their stribe and gradually drop from the higher grounds of the hills to the level of the plain below, being cut off by a fault which passes across the range here, and downwards to the South. There is not

therefore an extent of more than 400 yards in this direction in which the coal could be found. No trace of it is seen, and the only indication of its possible existence is the occurrence of a spring strongly impregnated with sulphuretted hydrogen. To the South of the coal again, the lime-stone and associated beds stretch along for less than 1½ mile towards the river, and here also are cut off by a fault, which throws out these beds altogether, so that this remarkable group does not come down to the bank of the Irrawaddy River at all. Along this distance numerous ravines cut the face of the hill and have been carefully examined, but excepting in one within 300 yards of the present coal pits, and immediately adjoining it, no trace of the coal was found. The season, undoubtedly, was very unfavorable for such examination. Every place was covered with the rankest vegetation, and much that would have been visible in the cold weather was thereby concealed. It is therefore just possible that patches of coal may appear, or may be hereafter seen along this escarpment, but I do not at all anticipate that any continuous bed or layer will be met with. The entire series of rocks, as I have mentioned, is of marine origin. Organic remains occur close above the coal, and close below it, which prove that the beds have resulted from deposition on a former sea-bed, and there is nothing, save the existence of the coal itself, and of a few scattered and imperfect markings of vegetable origin in the beds immediately connected with the coal, to point to a fresh-water, or even estuary origin, and I would scarcely hesitate to say that, should other deposits of such fossilized vegetables be discovered in this neighbourhood, they will be found to partake of the same irregular character as that I have above described, and to be nothing more than local patches or local accumulation, on the continuity of which no dependence could be placed.

As regards the geological epoch of these rocks, there is little doubt. The whole group of organic remains, which in some beds occur abundantly, at once, and very definitely, prove that they cannot be referred to the carboniferous or coal measure group of geologists. They are undoubtedly of the old or *tertiary* era, as was originally pointed out with regard to the rocks at Prome (a continuation of the same series as at Thayet-myo) by Dr. Buckland, from a comparison of the specimens collected by Mr. Crawford and Dr. Wallich during their trip to Ava.

I cannot conclude this Report without expressing the high sense I entertain of the exertions of Captain White, Assistant Commissioner at

Thayet-myo, in his endeavours to render this coal available, and of the persevering and quiet determination of purpose, with which he steadily followed up every indication of the occurrence of any thing like coal within his District. Were the local Officers in each district to make themselves equally well acquainted with the resources of their neighbourhood, the labours of the Geological Survey would be greatly lightened. The expense incurred in proving this coal (the exact amount of which I do not know) was most entirely justified by the promising appearances it at first presented, and any trials, short of what has been done, I should not have considered satisfactory.

I have also to express my personal obligations for the most friendly and hearty aid which Captain White afforded me in all my enquiries.

(Signed) THOMAS OLDHAM.

The 4th August 1855.

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